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*THE SUMMER'S WORK AT THE WOODS HOLE LABORATORY OF THE BUREAU OF FISHERIES (FORMER U. S. FISH COMMISSION).**

THE laboratory was thrown open on the sixteenth of June last for the nineteenth summer since the establishment of its present quarters, and scientific work was in progress until the end of September, after which time there remained but a single investigator. The work accomplished during the season is summarized below, together with mention of certain important lines of work which were planned and commenced. This statement has been prefaced by a brief account of the present equipment for scientific work at the station, although this latter of course varies but little from year to year.

I. EQUIPMENT.

Rooms.—In addition to the large laboratory room with nine tables, there were fourteen private rooms at the disposal of investigators, all of which are provided with gas and electricity and otherwise equipped for research. To this list must be added the library, supply-room and aquarium, as well as the main hatching-room, which, as usual, was available for laboratory purposes from the end of the lobster-hatching season, early in July. Through the courtesy of Superintendent Locke, certain other portions of the fish-cultural plant were also at the service of investigators. Early in the summer im-

* Report to the Commissioner of Fisheries by the director of the laboratory.

portant improvements were made in the plumbing of the main laboratory, and some others have been authorized which will be carried out before the opening of the following season.

Fleet.—The steamer *Fish Hawk*, the yacht *Phalarope*, the tug *Blue Wing* and two steam launches were available during the whole or a part of the season. A catboat and an abundance of row-boats complete the list.

Fish Pounds.—Both of these were set this year in Buzzards Bay, at points not far removed from the station. A daily record was kept by Mr. Edwards of the species taken, together with a rough estimate of the number of each. Such records, which have been kept for many years past, furnish valuable data concerning the annual migrations of fishes. The pounds constitute also one of the important sources of supply for the materials of investigation.

Library.—This comprised (1) the permanent collection, including about 16,000 titles, mainly reprints donated by the authors, and reports of our own and foreign governments; and (2) the collections loaned for the summer months by Brown University and the College of the City of New York, comprising about 650 and 100 volumes respectively. A subject catalogue was commenced by the librarian, Miss R. McDonald, in addition to the author catalogue already on hand.

Residence.—One floor of the large residence building was, as usual, at the service of those who had been employed by the bureau to carry on special investigations.

II. STAFF.

The staff of the laboratory during the season comprised a director, a librarian, a secretary, five salaried investigators, working upon special problems of interest to the fisheries, an assistant in charge of the supply-room, an assistant in charge of the fish pounds, and nine assistants, mainly college and medical students, doing miscellaneous work in the laboratory and in the field. To the above list must be added a collector, who is permanently attached to the station, and the crews of the various vessels while these are in service for the laboratory.

III. INVESTIGATORS.

The total number of investigators who availed themselves of the privileges of the laboratory during the summer past was thirty, the greatest number at any one time being twenty. These men represented two government departments and sixteen educational institutions, ranging from Alabama to Vermont and west to Illinois. The average length of their stay at the laboratory was almost exactly six weeks, though a few stayed nearly or quite twice that time. A brief statement of the work done by each of the investigators is given below.

IV. COLLECTING TRIPS.

Leaving out of account the daily visits to the pound nets, about forty collecting trips were made by the smaller steam craft. The localities visited were: Wareham, Monument Beach, Quisset, Hadley Harbor, Weepecket, Penikese, Cuttyhunk, Great Pond, Vineyard Haven, Muskeget, Katama, Gay Head and various points in Vineyard Sound. To this list must be added fifteen dredging trips made by the *Fish Hawk*, whose operations were confined almost exclusively to Vineyard Sound. The work of the *Fish Hawk* will be dealt with in a separate section. Mention should also be made of four days spent in camp by Mr. I. A. Field and an assistant at Menemsha Bight, Martha's Vineyard, where they were engaged in noting the fish taken in the numerous traps at that point, and of a journey to Provincetown, also by Mr.

Field, in quest of data relating to the food of the dog-fish.

The collector, Mr. Vinal N. Edwards, continued, as usual, the collection and preservation of fishes, fish parasites and other material of biological interest.

V. SEMINAR.

A seminar or research club was established early in the season, and thereafter met weekly until near the close of the summer. It was thought possible that cooperation might be profitable in certain lines of work, and in general it was thought desirable that there should be some recognized medium by which investigators might profit by the results of one another's work. The experiment proved entirely successful and the meetings were well attended. The first few of these were devoted to a discussion of plans relating to the catalogue of local fauna and flora, and to the proposed dredging work of the *Fish Hawk*. At the later meetings, reports were presented by investigators upon their work at the laboratory.

VI. CATALOGUE OF LOCAL FAUNA AND FLORA.

The compilation of a catalogue of the fauna and flora of the region, as far as known, was commenced by the director in cooperation with several others. The work, as projected, contemplates much more than a catalogue in the sense of a mere list of species. Certain data of practical or scientific interest are, when available, recorded for each of these. In order to permit of indefinite expansion, the whole record is to be in the form of a card catalogue, having eleven cards for each species. The *specific name* and *common name* (*local name*, whenever such exists) find their place on the first card; then follow in order '*relative abundance*,' '*geographical distribution*' (within region catalogued, of course), '*seasonal distribution*,' '*habitat*,' '*reproduction*' (breeding and spawning season, etc.), '*food*,' '*method of collecting*,' '*economic data*,' '*references*' and '*remarks*.'

The first step in the preparation of such a catalogue must consist in the sifting of the various published reports and papers containing the data desired. The classical report of Verrill and Smith upon the invertebrates of Vineyard Sound is, of course, one of the first to be utilized, as are also the numerous synopses of special groups published in the 'Bulletin' of the Fish Commission and elsewhere. In addition to these strictly faunistic papers, data relevant to the present work are to be found scattered through a large part of the biological literature emanating from Woods Hole—incidental observations on spawning-time, distribution, food and the like. Add to this the wealth of facts accumulated by Mr. Vinal Edwards, during his long experience as collector for the Fish Commission, and the large stock of information, as yet unrecorded, in possession of the numerous investigators who have occasion to collect material at Woods Hole. This only awaits a recognized receptacle, such as it is hoped that the present catalogue may become.

A fair start has already been made in the work of compiling this catalogue, many of the principal reports and synopses having been abstracted, and records of about 750 species having been entered. In this work Mr. Raymond C. Osburn cooperated with the writer, and several of the temporary assistants were engaged in the clerical work involved. The notes on the fishes, based upon the list prepared in 1898, by Dr. H. M. Smith, and supplemented by abundant data furnished by Mr. V. N. Edwards, are by far the most complete.

In this work, assistance has been promised by several systematists in compiling the records relating to their respective groups, and the active cooperation

of at least one of the botanists is assured, in the endeavor to have the flora, as well as the fauna, included in the catalogue. A liberal appropriation, which has been granted by the bureau, will enable the writer to continue this work during the present winter.

VII. DREDGING WORK OF THE 'FISH HAWK.'

The *Fish Hawk* arrived at Woods Hole on the nineteenth of July, and remained until September 10, during the greater part of which period she was at the disposal of the laboratory. It was thought that the admirable facilities for dredging possessed by this vessel could be put to greatest advantage by carrying out a systematic survey of the bottom of Vineyard Sound, a task which had not been undertaken since the days when Professor Verrill and his associates gathered the material for their reports on the invertebrate fauna of these waters.

Accordingly, dredgings were made at intervals of three fourths of a mile along parallel lines crossing the sound, these lines being constructed at intervals of one mile. Various sorts of dredges were employed, according to the character of the bottom, and frequently one spot or 'station' was covered by more than one sort of dredge. The usual physical data—density of water, character of bottom, temperature, etc.—were recorded for each station. Material for a complete record of the biological data has been preserved. The more familiar species were listed as they were taken aboard, record being kept of the condition and relative abundance of each. The remainder are at present represented by preserved specimens which await identification by experts. An even approximate list of the species taken can not, at present, be given. In all 82 'stations' are recorded in Vineyard Sound, ranging from Nobska Point to Gay Head. In addition, a trip was made to Crab Ledge, a shoal about seven miles east of Chatham, on Cape Cod, where seven stations were dredged.

It is planned that this dredging of the bottom of Vineyard Sound shall be continued and shall be supplemented by thorough work upon the shore life of this region, thus completing a biological survey of these waters. It is likely, too, that some sort of cooperation with the botanists will be arranged for. Such extensive plans can not, of course, be carried into effect without the employment of several specialists as assistants. The relation which such a survey would bear to the catalogue above discussed is obvious.

A regular form of collecting record blank was adopted for work of this character, and 2,500 copies were printed at the Government Printing Office.

Acknowledgment must here be made of the valuable assistance of Mr. R. C. Osburn, in connection with the dredging work; of the services of Dr. J. P. Moore and Dr. R. P. Bigelow, who identified respectively the annelids and the crabs collected; and of Dr. B. M. Davis and Miss Lillian McRae, who identified the algæ. Finally it must be mentioned that without the able and conscientious services of Capt. James A. Smith, in command of the *Fish Hawk*, the present measure of success would have been impossible.

VIII. OTHER INVESTIGATIONS.

In the brief statements given below, the language of the investigators themselves has been used as far as possible.

Robert Payne Bigelow, Ph.D., instructor in biology, Massachusetts Institute of Technology: (1) 'Stomatopoda of the Albatross Hawaiian Expedition,' (2) 'Brachyura of the Woods Hole Region.' During the spring there was placed in Dr. Bigelow's hands a collection of stomato-

poda gathered by the *Albatross* during the Hawaiian and Samoan expeditions of 1902. This collection was brought by him to Woods Hole, and his chief work during the summer was the sorting of this material and the identification of the known forms preparatory to making a detailed study of each species, with drawings. The collection is especially rich in larvæ, and the sorting of these has been done with a view to discovering series of stages, and the identification of larvæ with adult forms.

Dr. Bigelow also identified crabs collected by the *Fish Hawk,* and collected material in connection with his report on the Brachyura of the Woods Hole region, now in preparation.

Frank C. Carlton, graduate student in Harvard University: 'The Color Changes of some Fishes.' *Fundulus heteroclitus* was found to exhibit marked changes of color, depending primarily upon differences in the illumination. The skin is of a light gray color in the daylight, but is almost black in the dark. A fish put into a porcelain bowl and set in the light was found to change to a paler color, but the same fish put into a dish lined with black cloth remained dark, even if the illumination of the latter dish were the same as that of the white porcelain one.

The spinal cord of a fish which had previously shown the normal color changes was cut, and, after recovery from the shock of the operation, the fish was placed in the light. The posterior part now remained dark under all circumstances. This experiment seemed to prove that the change from dark to light is under nervous control.

From experiments in cutting the optic nerves of fishes whose color changes had previously been normal, it was concluded that light must influence the pigment cells through the eyes, since such fish did not show the reactions above described.

Leon J. Cole, Austin Teaching Fellow in Zoology, Harvard University: 'Studies upon Carp.' Material was worked over and notes compiled, based upon field work at various places on the Great Lakes during the past three summers. The results will be embodied in a report for the bureau.

Ulric Dahlgren, M.S., assistant professor of histology, Princeton University: Engaged in collecting material for histological studies.

George Wilton Field, Ph.D., assistant, Massachusetts State Board of Health: (I.) 'The Edible Lamellibranchs as a Source of Infection.' Together with Dr. C. A. Fuller, Dr. Field carried on, from August 10 to October 15, an investigation on the relations between shell-fish and sewage bacteria, and instituted experiments for the purpose of answering the following questions: (1) Are sewage bacteria (*Bacillus coli,* the type form) normal and usual inhabitants of shell-fish? (2) How soon after the introduction of *B. coli* into the water does it appear in the clam? (3) How long does *B. coli* live in ordinary sea water? (4) How long, under normal conditions, does *B. coli* remain alive and active in the intestine of the shell-fish? (5) Is it probable that the shell-fish digest *B. coli* and thus incidentally act as purifiers of the sewage-polluted waters, and, further, that by digesting *B. coli,* shell-fish may after a time become free from sewage-bacteria, and, therefore, harmless as food for man? (6) Examination to ascertain what anatomical region is most certain to give a true index of the presence of *B. coli.*

The methods used by Dr. Field and Dr. Fuller for securing proper conditions of infection with *Bacillus coli* and for main-

taining the normal conditions of life for the clams proved satisfactory. The results are probably to be published by the Massachusetts Board of Health in its annual report, and are believed to be of considerable importance.

(II.) 'The Lobster Problem.' At the request of Capt. J. W. Collins, chairman of the Fish and Game Commission of Massachusetts, Dr. Field secured at Woods Hole and Cuttyhunk important data concerning the lobster industry, bearing upon the biological importance of preserving the adult lobsters and permitting the catching of immature ones. Figures were obtained, indicating the commercial value, in terms of edible meat, of lobsters $8\frac{1}{2}$, $9\frac{1}{2}$ and $10\frac{1}{2}$ inches long respectively; also the weights and measurements (length, weight and diameters of chelæ, thorax and abdomen) of upwards of eight hundred newly caught lobsters, coming from different sections; and some observations upon the relative numbers of mature and immature lobsters in the ocean. In connection with the recommendation of a law which would insure the perpetual protection of the adult lobster, experiments were made looking toward the adoption of a pot which would exclude lobsters above eleven inches in length, and permit the escape of those under nine inches. The result of this would be the automatic regulation of lobster catching to practically only those sizes which fell between nine and eleven inches. These results will be published as soon as possible.

Irving A. Field, Denison University: 'The Food of Certain Fishes of Little or no Food-value' (conducted for the bureau). The fishes chosen were the smooth dog-fish (*Mustelis canis*), killifish (*Fundulus heteroclitus*), cunner (*Tautogolabrus adspersus*) and toad-fish (*Opsanus tau*), all of which are common in the vicinity of Woods Hole. The purpose of the study was to seek for the possible economic relation which these fishes might bear to the fisheries industries. Are they destructive either to other fishes directly or to their food?

The method employed in these investigations was to take a great number of these fishes from various localities about Woods Hole and to preserve the stomach-contents of each as soon as possible after death. The various ingredients composing the contents of each stomach were ascertained quantitatively, the approximate percentage of each ingredient being estimated, and whenever possible, the total number of any given sort of animal which had been swallowed was determined. From data thus obtained a tabulated record was made out, including the date and locality of capture, number of specimens (fishes) examined, and the number of specimens containing each kind of food. A few preliminary experiments were also made with the dog-fish for the purpose of finding products that would make it of commercial value. Its food value was likewise tested. The results will shortly be ready for publication.

Caleb Allen Fuller, Ph.D., Providence, R. I: Assisted Dr. G. W. Field in the experiments above described.

Frederic P. Gorham, Ph.D., associate professor of biology, Brown University: 'Causes of Certain Fish Diseases' (conducted for the bureau). (1) An attempt to study the life-history of a fungus pathogenic to lobsters; to determine the paths by which the infection reaches the internal tissues of the lobster; to devise methods of combating the fungus. (2) With Mr. Marsh a very careful study was made of the causes operating in the production of the gas disease and 'pop-eye' in fishes kept in the aquaria (see below).

(3) Some experiments were made to determine the effects of different kinds of metal piping on fishes and other forms of life in aquaria. (4) Some experiments with phosphorescent bacteria obtained from sea water, to determine the part played by them in the production of phosphorescence in various crustacea.

John Y. Graham, Ph.D., professor of biology, University of Alabama: 'A Study of a Parasite of the Oyster (*Bucephalus cuculus* McC.).' This trematode, though very common in the region of Beaufort, N. C., and doubtless elsewhere on the southern coast, was not found in any of the oysters of the region near Woods Hole, although large numbers of the latter were examined, coming from Wareham River and Buzzards Bay. Dr. Graham was consequently obliged to confine his attention to the material which he had collected two years before at Beaufort. From a study of this, a careful account is now possible of the structure of the most advanced cercaria stages, which will perhaps give us a clue to the identity of the adult form, the latter being without doubt some species of the genus *Gasterostomum*.

Clarence W. Hahn, A.M., graduate student, Harvard University: (1) 'On Dimorphism in *Metridium marginatum*.' Regeneration experiments begun the year before and continued during the past summer led to the conclusion that the diglyphic Metridia are typical, and that the monoglyphic individuals arise by asexual budding from the base of the body or column. This method of reproduction is very common. The diglyphic condition is not transmitted asexually. The method of regeneration was also worked out. A new pair of directives is usually produced on the regenerated side of the young polyp. (2) 'On the Blood Parasites of the Turtle.' As a result of studies begun at Harvard and continued at Woods Hole, Mr. Hahn believes that he has established the existence of three kinds of adult individuals, with distinct life cycles similar to those described by Huitzi ('02) for *Drepanidium ranarum* of the frog. There was found to be an asexual form, which reproduced by a process of sporulation different from that of the sexual individual. In the sporulation of the latter, a process of mitosis was found to occur. The adult sexual hæmogregarine, which is worm-like in form, is believed by Mr. Hahn to be identical with the vermiform parasite described by Siegel ('03) in the leech, *Placobdella catenigera*.

Arthur D. Howard, M.S., graduate student, Harvard University: 'Minute Structure of the Rods of the Retina of Fishes.' Mr. Howard continued studies, previously made upon higher vertebrates, now using various fishes. Retinæ of the following forms, among others, were examined with the polarizing microscope, and confirmation of previous results obtained; butterfish, squeteague, sand-dab, king-fish, menhaden, barracuda, eel, tautog, bonita, cutlass-fish, smooth dog-fish and skate.

Lynds Jones, M.S., instructor in zoology, Oberlin College: 'The Food of Marine Birds.' The investigations were made on Weepecket, Penikese and Muskeget Islands. Stomachs of young terns were examined, and the feeding of the young by the parent, as well as the feeding of the adult birds, were carefully examined. Mr. Jones gives the following estimate of the tern population of the various islands where they nest: Weepecket, 2,000; Penikese, 10,000; Muskeget, 80,000; total, 92,000 terns. The two species (*Sterna hirundo* and *S. dougalli*) are represented in about the proportion of two to one. The feeding habits and food of the two are the same. The

estimated number of fishes eaten in this region by terns in the course of one day is estimated by Mr. Jones as follows:

	Per Cent.	
Ammodytes americanus.....	80	736,000
Tautogolabrus adspersus.....	8	73,600
Mugil curema.....	4	36,800
Pollachius virens.....	3	27,600
Clupea or *Pomolobus*.....	3	27,600
Pseudopleuronectes americanus....	2	18,400
	100	920,000

Mr. Jones concludes that the number of food fishes consumed by terns is a negligible quantity. The food of the gulls, loons, kingfishers, osprey and ducks was not studied.

Austin P. Larrabee, A.M., graduate student, Harvard University: 'The Effect of Heredity on the Dimorphism exhibited in the Optic Chiasma of Teleosts.'

Edwin Linton, Ph.D., professor of biology, Washington and Jefferson College: 'Investigations on the Parasites of Fishes' (conducted for the bureau). From August 13 to September 6, about 150 fishes, representing 32 species, were examined. In addition to this, a preliminary examination was made of material which had been collected by Mr. Vinal N. Edwards at various times during the past four or five years, comprising parasites from 27 species of fish and two mammals. The greater part of this collection consisted naturally of comparatively large and common species of parasites. In some cases, however, where the entire viscera had been preserved in formalin, many small and rare forms were found which would certainly have been overlooked by the general collector.

The plan of investigation of the fresh material consisted in making careful search for parasites in the alimentary tract and body-cavity, on the gills and occasionally in the muscular tissue of the fish. So far as time would admit, sketches and measurements were made, especially of varying states of contraction in the soft-bodied forms. Note was also made of the color, relative abundance, place of occurrence in the host, etc.; and particular attention was given to diseased conditions resulting from the presence of parasites. The nature of the food was also noted, since the character of the food may sometimes furnish a clue to the discovery of the intermediate host.

Thus far but little has been accomplished in working out the life history of the parasites of fishes. Some hint of the source of infection may be obtained by noting the relative abundance of parasites in the different seasons of the year. For this reason, such collections as those of Mr. Edwards are especially valuable.

Of forms which are new, or at least which have not been reported before, there were found: One species of the order Acanthocephala, two of the order Nematoda, six of the class Trematoda, and four of the class Cestoda. The results of this summer's work will be made the subject of a special report.

Joseph A. Long, graduate student, Harvard University: 'The Reaction of Eyeless (Blinded) Fish to Light.' The fish used were *Fundulus majalis* and *F. heteroclitus*. By using an aquarium provided with an electric light, and covered with black cloth in such a way that one half was darkened and the other half was in bright light, it was found that normal fish in good condition were decidedly phototropic in a positive way. After observations had been made on the normal fish, the optic nerves were cut, and the previous experiments repeated. No evidence was found that in *Fundulus* there were sense organs in the skin or lateral line that were responsive to light.

M. C. Marsh, pathologist of U. S. Bureau of Fisheries: 'The Causes of the

Gas-disease of Fishes.' This work, which was carried on jointly with Professor Gorham, was directed toward discovering the cause of 'pop-eye' due to gas, and the causes of mortality among fishes in the local aquarium whether with or without 'pop-eye.' It was found that the sea water from the supply pipes of the station, when delivered below the surface of the water in an aquarium, was fatal to most species of fishes after a longer or shorter time, *Fundulus* being most resistant; that when the water delivered was first somewhat broken up, causing it to spatter or spray, the mortality tended to lessen, and 'pop-eye' to decrease; that when the deaeration process was sufficiently complete, the 'pop-eye' and the mortality were prevented completely.

By placing fishes (scup) under various air pressures greater than the atmospheric, in the same water which ordinarily produced 'pop-eye' and killed the fish, the 'pop-eye' and the mortality were found to be checked, being inhibited altogether by a pressure of between six and seven pounds per square inch.

Scup adjusted to surface pressure for one week were as susceptible as those brought directly from the fish traps, which had probably come from somewhat deeper water. Artificial reduction of air pressure produced the same gaseous lesions as those which had been shown by fishes in the aquaria under the influence of the local water supply, viz., 'pop-eye,' gas blebs, death with free gas in the blood vessels, according to the degree and the duration of the reduction. Death occurred in a few hours at a pressure reduced to less than that of twenty inches of mercury.

Determinations showed that the aquarium water has a proportion of dissolved gas considerably in excess of that from the basin or harbor. This excess is believed by the investigators to be caused by the hydrostatic pressure of the supply system, in conjunction with leaks in the suction pipe which admit air to the water immediately prior to its being pumped to the supply tank. This excess of gas in solution consists of one or more of the constituents of air.

The immediate cause of death was usually found to be the presence of free gas in the blood vessels. According to the investigators, this free gas is formed in the following manner: The blood of fishes living in this supersaturated water takes up, while in the gill capillaries, more than the usual amount of gases, thus reaching nearly or quite to the saturation point. These gases are, however, liberated as soon as the blood becomes raised to a higher temperature in the systematic circulation, thus continually accumulating in the vessels.

Samuel Steen Maxwell, Ph.D., instructor in physiology, Harvard Medical School: 'Comparative Study of Muscular Tonus.' The phenomena of muscular contraction were studied in a somewhat wide range of forms. Especial attention was given to the occurrence of spontaneous or rhythmic contractions in muscles or muscle groups separated as completely as possible from the influence of nervous tissues. Among the forms investigated were *Nereis, Crepidula, Modiolus, Mytilus, Homarus, Libinia, Limulus, Carcinus, Mnemiopsis* and *Gonionemus.*

In order to retain the muscle alive for a sufficient period of time, it seemed necessary to find a solution which could be used upon the tissues of marine animals in the same way as the customary physiological salt solution is used upon the tissues of land animals, and considerable time was devoted to experiments along this line.

A full report of the experiments will be published as soon as possible.

J. Percy Moore, Ph.D., instructor in zoology, University of Pennsylvania: 'A Synopsis of the Annelids of the Woods Hole Region' (prepared for the bureau). The families Cirratulidæ, Maldanidæ, Ampharetidæ, Terebellidæ and Sabellidæ have been completed. Several new species were discovered and descriptions prepared for publication, one of the most striking of which is a large and handsome species of *Trinia*. A number of hitherto unrecorded species have been added to the known fauna, among them tropical species of *Hipponoe* and *Euphroryne* transported by the Gulf Stream on barnacle-laden logs. *Tomopteris* was taken in the tow at the Fish Commission wharf. Valuable data concerning the exact distribution of species were derived from the trawlings of the *Fish Hawk* and from shore collections.

Raymond C. Osburn, graduate student, Columbia University. Mr. Osburn cooperated, as a salaried assistant, in the compilation of the card catalogue of local fauna and flora (see above), and in the work upon the dredging material obtained by the *Fish Hawk*.

George Howard Parker, Ph.D., assistant professor of zoology, Harvard University: 'Physiology of the Lateral-line Organs' (research conducted for the bureau). Six species of fishes were tested: dog-fish, skates, killifish, scup, toad-fish and winter flounder. In each species individuals with normal lateral lines, and those in which the nerves going to the lateral-line organs had been cut, were tested. The most complete series of tests covered temperature, salinity, oxygen pressure, carbon dioxide, foulness, water-pressure, water-currents, water-vibrations of high and of low frequency. Differences between fishes with and without lateral-line organs were noticed only in relation to vibrations of low frequency (six per second). It was, therefore, concluded that the lateral-line organs are stimulated by water vibrations of low frequency.

Henry Farnham Perkins, Ph.D., instructor in biology, University of Vermont: 'Studies of the Morphology of Hydromedusæ.' Collections were made in the eel pond during a preliminary visit early in May, and many immature specimens of *Gonionema murbachii* were taken, also some *Willia ornata* and scattering specimens of other genera. Dr. Perkins's aim was to find the young of *Gonionema* in the process of transformation into the medusa form, but the earliest of the young stages found possessed all of the adult characters. Many young medusæ were preserved with a view to studying the development of the tentacles and sense organs. All of these specimens showed the remarkable scheme of origin of the tentacles mentioned in a previous paper by Dr. Perkins. A number of specimens of *Hybocodon prolifer* were taken in the deep water outside the harbor. Many of these exhibited not only the asexual reproduction by budding at the base of the parent tentacle, described and figured by Agassiz and others, but also sexual reproduction in the same individuals, larvæ being developed in the ectodermal tissue of the manubrium, and escaping as actinulæ.

July 6 to August 4, mature specimens of *Gonionema* were collected on nearly every day, and the eggs obtained from these were reared in a variety of ways with a view to having the larvæ mature in the laboratory. Many thousand polyps are now under observation. A careful study of the sexual reproduction of *Hybocodon prolifer* was made during this time and a paper was prepared for publication. Constant watch was kept for specimens of medusæ in the waters about Woods Hole,

but very few specimens were found, and none at all of unusual interest. Experiments were carried on in order to find under what artificial conditions it was possible to rear larvæ of various medusæ, and to keep the adults in good state for observation. Observations were also made upon the degeneration of tentacles in *Gonionema*.

Amos W. Peters, Ph.D., instructor in physiology, University of Illinois: 'Studies on the Phosphorescence of Ctenophores.' Efforts were directed toward the following ends: (1) To follow the phenomenon back through the ontogeny of the animal; (2) to the determination of the influence of light upon the deposition of eggs; (3) to the relations between phosphorescence and various stimuli.

W. O. Richtman, expert in pharmacognosy, U. S. Department of Agriculture: Assisted Dr. True in his experiments upon artificial sea waters.

G. F. Ruediger, M.D., Memorial Institute for Infectious Diseases, Chicago (Rush Medical College): 'Bactericidal Properties of Sera of Marine Animals.' The object of this work was to find a normal blood serum, in cold-blooded animals, which would be destructive to streptococci. Sera from butter-fish, dog-fish, conger-eel, flounder, mackerel, dusky shark, sand-shark, scup, squeteague, butterfly-ray, sting-ray, common skate, squid, lobster, spider-crab, king-crab, snapping-turtle, painted turtle and spotted turtle were used. Streptococci were found to grow well in all of these sera, excepting those of the painted turtle and spotted turtle. These two sera seemed to kill off large numbers of organisms from some cultures of streptococci, other cultures, however, not being affected. Heating the serum destroyed its bactericidal properties. An attempt was also made to immunize dog-fish, but lack of time prevented conclusive results.

Geo. G. Scott, M.A., tutor in the College of the City of New York; assistant in charge of supply-room, at the laboratory: 'Studies of the Gregarines.' Numbers of invertebrates were examined for gregarines. None were found in the blue-crab, lady-crab, spider-crab, king-crab, squid nor *Phascolosoma*. In the lobster, specimens of the gregarine, *Porospora gigantea* were found, almost every lobster having cysts of this parasite in the folds of the rectum. Gregarines were also found in *Cirratulus*, *Nereis* and *Clymenella*. In *Cynthia*, the movements of a gregarine were observed carefully and camera drawings were obtained, representing the changes of shape. Several specimens of *Amphitrite* showed pathological enlargements beneath the ectoderm of the body wall. These are as yet undetermined.

John A. Shott, A.M., professor of biology and physics, Westminster College: 'Phototaxis in Copepoda' (in cooperation with Dr. Parker). The problem was to determine the reactions of the copepods in a graded field of light when they were started toward the source of light. The work was done during the last two weeks of July, at which time the copepods were difficult to obtain, so that the results were not conclusive.

Grant Smith, graduate student, Harvard University: Assisted Dr. True in experiments upon artificial sea water, also carried on experiments upon phototactic responses of star-fish.

Francis Bertody Sumner, Ph.D., instructor in zoology, College of the City of New York; director of laboratory: (1) 'Card Catalogue of Local Fauna and Flora,' commenced, with cooperation of Mr. R. C. Osburn (see above); (2) 'Dredg-

ing Survey of Vineyard Sound' (see above); (3) 'A Statistical Study of *Fundulus majalis* with a view to the determination of selective characters.' During the preceding summer large numbers of this fish were placed in aquaria from which the water was turned off. When about half had died, the living and the dead, *i. e.*, the survivors and non-survivors, were preserved. This year, nearly a thousand of these fish were carefully measured by two assistants, Messrs. C. R. Metcalf and W. H. Curtiss. Nine measurements were made for each fish. The rather formidable task of making the desired computations from these figures has scarcely been commenced, but enough has been done to show the existence of certain measurable characters of selective value.

Millett T. Thompson, Ph.D., instructor in zoology, Collegiate Department, Clark University: (1) 'Crustacean Metamorphosis'; (2) 'Studies of the Head and Alimentary Canal of Diptera.'

Rodney H. True, Ph.D., physiologist of Bureau of Plant Industry: 'Artificial Sea Waters as tested in Aquaria' (assisted by Mr. W. O. Richtman). At the suggestion of Mr. W. De C. Ravenel, representative of the Bureau of Fisheries at the St. Louis Exposition, experiments were made under the authority of the Secretary of Agriculture, and of the Commissioner of Fisheries in order to determine, if possible, in how far it may be practicable to make artificial sea water, capable of sustaining marine plant and animal life.

Experiments were made with artificial sea water prepared in two ways: (1) By dissolving in distilled water the complete salts of the sea, obtained by evaporation; (2) by dissolving in distilled water chemically prepared salts in proportions determined by analysis. The *Challenger* analyses by Dittmar were used. Aquaria were provided with artificial waters prepared according to each of these methods and with sea water dipped up from the current at the end of the wharf at the Woods Hole station. Two sets of such aquaria were prepared: (1) Standing aquaria kept at constant salt content by the addition of fresh water; (2) aquaria through which a small stream of water was kept flowing, providing thereby a system of closed circulation.

Aquaria thus prepared were stocked with both plant and animal life; the plants most used being green forms common at Woods Hole: *Cladophora, Enteromorpha, Ulva* and *Aghardiella tenera.* Many types of animal life were studied, including, especially, sea-anemones (*Metridium*), star-fish (*Asterias*), medusæ (*Gonionemus*), squid (*Loligo*) and fish (silversides, scup, pipe-fish, etc.).

The general result may be summed up as follows: Sea-anemones seemed to flourish during the period under observation in all media. Star-fish survived and behaved normally in the water made from evaporated sea salt, in cases, however, showing symptoms of injury in the synthetic solution. *Gonionemus* survived for several weeks in both solutions, but appeared to suffer from other forms of life with which it came in contact. The squid could not be made to survive for more than a few days in any medium, artificial or natural. They died in the synthetic solution in less than ten minutes with violent symptoms; they survived in the other artificial solution as long as in the natural sea water. Fish seemed in all cases to live as well in the artificial solution as in the natural, including delicate forms, like *Menidia.* Several other forms of fish and invertebrates were tested in various ways, with the general result that the artificial solution made from the salt obtained by evaporation permitted survival to a degree

not clearly different from that seen in sea water. The synthetic artificial solution seemed equally favorable to most forms, but distinctly less so to a few.

FRANCIS B. SUMNER.

SOCIETY OF THE VERTEBRATE PALEONTOLOGISTS OF AMERICA.

THE second meeting of this society was held at Philadelphia, December 29, 1903, in the Biological Hall of the University of Pennsylvania. In the absence of the president, Professor S. W. Williston, the chair was taken by Professor H. F. Osborn.

The following are abstracts of papers which were read and discussed:

A Remarkably Preserved Specimen of a Pelycosaur Collected During the Last Summer in Texas: DR. E. C. CASE.

The specimen has afforded a nearly complete skull and the anterior part of the vertebral column, with the incomplete fore limbs of both sides. The most important addition to our knowledge is in the anatomy of the articular region of the skull and lower jaw. The specimen shows that the author, in collaboration with Dr. Baur, was in error in ascribing to the articular region of the skull what belongs to the articular region of the lower jaw. The quadrate is, therefore, not a depressed bone largely covered by the bones of the temporal region, squamosal and jugal, but it is elevated and very similar in appearance and relations to the same bone in *Sphenodon*. There is a foramen between the lower end of the quadrato-jugal and the quadrate, as in *Sphenodon*. The finding of this foramen removes the last possible question as to the position of the Pelycosauria in the order Rhynchocephalia. There are two temporal arches present.

In the Matter of Menaspis: DR. BASHFORD DEAN, Columbia College.

Professor Bashford Dean discussed the relationship of the puzzling Permian fish, *Menaspis*, pointing out that on the evidence of an unfigured specimen in the Berlin Museum, which, thanks to the courtesy of Professor Jaekel, he had recently had the privilege of examining, there were grounds for regarding this form as distinctly chimæroid. The present specimen retains the dental plates, and from their size leads us to conclude that the region of the fossil regarded by earlier writers as the hindmost trunk region (terminating in blunt spines) is in reality the occiput. He compared the tuberculated spines of *Menaspis* with those of *Myriacanthus*, referring especially to an unfigured specimen of this form to which Professor E. T. Newton called his attention in the Paleontological Museum in Jermyn Street. The puzzling non-tuberculated spines of *Menaspis*, on the other hand, best correspond to the so-called lip cartilages of *Squaloraja*. Such structures, moreover, would be apt to take a position dorsal to the antero-ventral lateral head spines during fossilization. Accepting this comparison, *Menaspis* indicates that in matters of dermal defenses and teeth the Permian chimæroid resembled contemporary cestraciont sharks.

On Some Famous Old Collections and Early Studies of Monte Bolca Fishes: C. R. EASTMAN.

This paper reviewed the pre-Linnæan discussions as to the nature and origin of the famous fossil fish fauna of Monte Bolca, in northern Italy, with a notice of the principal contributions to the literature made during the last century. The history was given of several large Veronese collections containing important type material, and where the latter had become dispersed, the present location was indicated of such as is now preserved amongst different museums.

On the Finding of Skulls of Trionychidæ in the Bridger Deposits of Wyoming: Dr. O. P. Hay, American Museum of Natural History.

More than twenty species of fossil Trionychidæ have been described from the Cretaceous and Tertiary deposits of North America. All these have been based on more or less incomplete shells. No skulls have hitherto been found. During the past summer a party from the American Museum of Natural History was engaged in collecting in the Bridger Eocene of Wyoming. Among many other turtle remains secured were two skulls of Trionychidæ. One of these is very large, having a total length of more than six inches. The lower jaw is missing. The form is strikingly like that of the skull of *Platypeltis ferox* of the southern states; but the snout is broader, the inter-orbital space is wider and the choanæ are constricted, as in *Aspidonectes sinensis*. The species is named *Aspidonectes tritor*. A skull of another species is much smaller and is accompanied by the lower jaw.

These specimens show that since the Eocene there has been no important change in the structure of the Trionychidæ. Dr. Baur was led to the same conclusion regarding the Trionychidæ of the Upper Cretaceous, from the examination of shells and limb bones from the Laramie of Wyoming. Shells from the still older deposits of the Judith River and Belly River beds similarly give indications that the members of this group have undergone little change since the early periods of the Upper Cretaceous. We must, therefore, look to discoveries in the fresh-water deposits of the Lower Cretaceous or of the Jurassic for light on this group.

The Grasping Power of the Manus of Ornithomimus altus Lambe: Lawrence M. Lambe, of the Geological Survey of Canada.

The description of the manus is based on materials found by the writer in the Belly River deposits of Alberta, Canada. The pes of *O. altus* shows that the animal was adapted to swift running. The manus can not yet be wholly reconstructed, but the claws were quite different from those of *O. sedens*. *O. altus* may be regarded as the successor of *Ornitholestes hermanni* Osborn, and there are many similarities in the manus of the two. The manus of *O. altus* is much stouter and less elongate, but it probably had equally great grasping power. The phalanges of what is supposed to be the second finger were described. A channel between the condyles of the distal end of the first phalanx extends through an angle of about 223°. The amount of rotation which the second and distal phalanges may make is very great. *O. altus* probably pursued a rapid prey and grasped it tenaciously with its fore limbs. Evidently the claws were long and sharp.

On Some Marine Fossils in the Titanothere Beds: Dr. F. B. Loomis, Amherst College.

On Bear Creek, near the Cheyenne River, South Dakota, in the lower part of the Titanothere horizon of the Oligocene, were found about seventy-five baculites and parts of a *Platecarpus*, these being Ft. Pierre species. These occurred in concretions and had a limited distribution. Their presence was explained by river action, the fossils having been excavated from the Ft. Pierre and redeposited during the building up of the Titanothere beds.

The Relationships of the Phytosauria: Dr. J. H. McGregor, of Columbia University.

This group of reptiles, represented by the belodonts of the European and American Triassic, were regarded by Huxley as constituting a primitive division of the crocodiles, for which he proposed the sub-

ordinal name Parasuchia. Though Huxley's view has received quite general acceptance, several paleontologists, notably Marsh, Baur and E. Fraas, have observed certain resemblances to *Sphenodon* and the dinosaurs. The present studies of the group, based chiefly upon extensive material recently discovered in Germany and in North America, have cleared up most of the doubtful points of the skeletal morphology, and it may be said that, save for the carpus and tarsus, the phytosaurian skeleton is now pretty well known. Nearly all the newly discovered structures indicate that the affinity to crocodiles is much more remote than Huxley supposed, and certain characters of the skull and atlas alone preclude the possibility that these forms were ancestral to crocodilia. The strong general resemblance between the two groups is chiefly superficial or parallel adaptation to similar habit and environment.

The relationship of phytosaurs to carnivorous dinosaurs, on the contrary, is obscured by the adaptive or secondary differences correlated with bipedal habit in the latter animals; but careful comparison of the skeletons shows that the relationship in this case is scarcely more remote than the relationship with crocodiles. The group which undoubtedly stands nearest the phytosaurs comprises the small armored Aëtosauria; in fact, the phytosaurs are chiefly distinguished from these animals by the prenarial elongation of the snout. For this reason it seems best to place the two groups as suborders within a single order, to designate which Huxley's subordinal name Parasuchia may be taken in a more inclusive sense and raised to ordinal value. The derivation of these Parasuchia from Rhynchocephalian ancestors scarcely admits of doubt; they might be briefly described as Rhynchocephalia which have acquired strongly bicipital ribs, thecodont dentition and a dermal armature.

Evidence was also adduced to show genetic affinity between Phytosauria and Ichthyosauria. Many structures, especially in the skull and limb girdles, indicate derivation of both from a common ancestor at no very remote period.

On the Position of the Bones of the Forearm in the Opisthocœlia or Sauropoda: HENRY FAIRFIELD OSBORN.

In the Sauropoda the forearm is modified in adaptation to support a very great weight in a manner entirely analogous to that in the Proboscidea, namely, the forearm is completely rotated inward, bringing the thumb, or first digit, on the internal side of the foot; the ulna is also enlarged proximally until it covers the entire posterior face of the radius. This gives rise to a deceptive appearance of the shafts of the radius and ulna, and has led to the statement that these elements do not cross. Careful study of the entire forearm, however, shows that the upper end of the radius rises from the radial condyle which is on the external side of the lower end of the humerus below the deltoid crest; on the front surface of this condyle is a groove for the main flexor of the forearm; immediately below this condyle the radius is articulated, and on its front face is seen the rugosity for the attachment of the flexor tendon which passes through the groove in the radial condyle above; these relations fix the radius on the *external* side of the limb proximally; distally the radius is found on the *internal* side articulating with the scapho-lunar and supporting the radial digit, or thumb. The ulna is also strongly developed on the external side of the limb proximally, and extends behind the radius around to the internal side, its primary position; the shaft of the ulna descends and articulates with the ulnare on the external side of the limb inferiorly. Thus when seen in front view the shafts of the radius

and ulna actually cross each other, although as in the Proboscidea this crossing is much less apparent, owing to the great proximal expansion of the ulna.

On the Use of the Sandblast in Cleaning Fossils: Henry Fairfield Osborn.

The introduction of the compressed air chisel by the Field Columbian Museum has greatly reduced the cost of removing rock from fossils. This chisel has been introduced also in the National Museum with success. For larger masses of rock it answers every purpose. The writer has recently been experimenting with a sandblast, driven by a compressed air engine, with admirable results. This method is peculiarly adapted to the finer work. It should be used under fifty-pound pressure, with tubes of fine diameter. Although not thoroughly tested as yet it promises to give remarkable results both in cleaning surfaces and in removing the matrix in the cavities of small skulls. Combined with the compressed air chisel it will probably reduce the cost of preparing fossils to one third of that involved by the use of hand tools.

Conclusive Paleontological Evidence for the Tritubercular Theory: Henry Fairfield Osborn.

That part of the tritubercular theory which homologizes the cusps composing the main triangle in the upper and lower grinding teeth of mammals, has been seriously questioned of late; first, because it does not accord with all the embryological evidence, second, because the superior premolar teeth appear to afford a demonstration that the upper molar teeth evolved in a manner which was subsequently pursued by the premolars. The tritubercular theory has been steadily losing ground; some authors have recommended that the cusp homologies and terminology be totally abandoned. A fresh investigation of the paleontological material available has, however, demonstrated beyond question the truth of the theory in its original form.

The superior molars of *Triconodon* and of *Peralestes* in the British Museum support the original view that the cusp (protocone) homologous with the reptilian cone is internal or lingual in position. Through the kindness of Professor Charles E. Beecher, the superior molar teeth of the Jurassic *Dryolestes* in the Yale Museum have been reexamined, and are found to correspond exactly both with the original description of Marsh and with the conditions set forth in the original tritubercular theory. The main cusp, or protocone, is internal and supported on a stout fang; the secondary cusps, representing the para- and metacones, are external and supported on lesser fangs. This evidence, together with that deduced from comparative anatomy and paleontology, establishes the tritubercular theory beyond further question.

A Reclassification of the Reptilia: Henry Fairfield Osborn.

The Reptilia are divided into two subclasses: (1) Synapsida, including the Cotylosauria, Anomodontia, Sauropterygia and Testudinata. The Anomodontia are divided into the Therocephalia (Broom), the Theriodontia (Cynodontia Owen), the Dicynodontia, representing progressive phases of evolution of the skull and specialization of the teeth. Of these the Theriodontia stand nearest the Mammalia. (2) Diapsida, embracing the new superorder Diaptosauria, which includes the seven orders and suborders Procolophonia, Protorosauria, Proganosauria, Gnathodontia, Choristodera, Pelycosauria and Rhynchocephalia. The remaining Diapsidan orders are the Parasuchia (= Phytosauria), Ichthyopterygia, Crocodilia, superorder Dinosauria, superorder Squamata and the order Pterosauria. Birds sprang

from a stem near that which gave rise to the Dinosauria.

The paper is an abstract, with some additions, of the memoir 'The Reptilian Subclasses Diapsida and Synapsida and the Early History of the Diaptosauria' (*Mem. Amer. Mus. Nat. Hist.*, Vol. I., November, 1903).

On the Primary Components of Vertebræ and Their Relations to Ribs: HENRY FAIRFIELD OSBORN. Read by title.

The vertebræ of the Stegocephala and of certain Permian Reptialia and the embryonic vertebræ of *Hatteria* establish beyond question the fact that there are four pairs of primary components, to which the names neurocentra, pleurocentra, hypocentra and hypocentra-pleurale may be given. Each is present in pairs on opposite sides of the notochord and neural tube. The 'neurocentra' correspond with the neural arches or neuropophyses of authors. The 'pleurocentra' (Cope) form the main components of the vertebræ in the Reptilia, Aves and Mammalia, and probably also in the Amphibia, although this fact has been questioned by Baur and Cope. The 'hypocentra' were first named by Gaudry, and subsequently termed 'intercentra' by Cope; they are primarily paired elements lying on either side of the notochord below and anterior to the pleurocentra; by Cope and Gadow it has been held that they form the main components of the vertebræ in certain if not in all Amphibia. The 'hypocentra-pleurale' (Fritsch) lie in pairs below and posterior to the pleurocentra; they are only found in certain Stegocephala. The vertebral complex thus made up is modified by the degeneration of the hypocentra-pleurale and in many forms of the hypocentra; by the development of the pleurocentra uniting with the neurocentra to form the centrum and neural arches.

Both on paleontological and embryological evidence the ribs always rise primarily opposite the hypocentra; they are thus placed between the pleurocentra and may be described as 'intervertebral' or 'intercentral.' The capitulum of the rib is hypocentral while the tuberculum is pleurocentral in attachment. Secondarily the capitulum may migrate to the side of the pleurocentrum, and the tuberculum to the side of the neurocentrum. This rib migration, observed independently in many different orders of reptiles, proves that the position of the head of the rib can not be adduced as evidence of the homology of that portion of the vertebral complex to which it is attached.

Mr. G. I. Adams, of the U. S. Geological Survey, read a paper entitled 'The Differentiation of the Permian in the United States, and the Diagnostic Value of Reptiles as Indications of Permian Age.' No abstract has been furnished.

Other papers by Messrs. J. C. Merriam, H. F. Osborn, Wm. Patten, E. S. Riggs, W. J. Sinclair and S. W. Williston were read by title.

Before adjournment Professor H. F. Osborn was elected president and O. P. Hay secretary for the ensuing year.

O. P. HAY,
Secretary.

THE MEMBERSHIP OF THE AMERICAN ASSOCIATION.

THE following persons have completed membership in the association since the publication of the list contained in SCIENCE of December 25, 1903:

Adams, Charles Francis, Head of Science Dept., Central High School, Detroit, Mich.

Aitken, Robert G., Lick Observatory, Mount Hamilton, Cal.

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Andrews, Clement Walker, Librarian, The John Crerar Library, Chicago, Ill.

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Basquin, Olin H., Associate Professor of Physics, Northwestern University, Evanston, Ill.

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Proctor, Chas. A., Department of Physics, University of Missouri, Columbia, Mo.

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Summa, Hugo, M.D., Professor of Medicine, St. Louis University, St. Louis, Mo.

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Walton, L. B., Professor of Biology, Kenyon College, Gambier, Ohio.

Weidman, Samuel, Geologist, Wisconsin State Geological and Natural History Survey, Madison, Wis.

Wetzel, Reinhard A., Supt. Science High School, Fargo, N. D.

Wilcox, Guy Maurice, Professor of Physics, Armour Institute, Chicago, Ill.

Willett, James R., 434 W. Jackson Blvd., Chicago, Ill.

Williams, Frank Blair, Ph.D., Assistant Professor Civil Engineering, Union College, Schenectady, N. Y.

Wilson, Delonza Tate, Case School of Applied Science, Cleveland, Ohio.

Wiseman, Carl Marshall, Optician, 301 W. Chestnut St., Louisville, Ky.

Woods, Carl Fred, Dartmouth College, Hanover, N. H.

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SCIENTIFIC BOOKS.

Ueber die Organization und Physiologie der Cyanophyceenzelle und die mitotische Teilung ihres Kernes. Von E. G. Kohl. Jena, Gustav Fischer. 1903. Pp. 240, 10 plates. 20 mk.

This book, the result of several years of work on this interesting group of algæ on the part of Professor Kohl, will probably clear away definitely many of the clouds of doubt and contradiction over the structure of the cell of these plants. Professor Kohl applied his attention first to one species, *Tolypothrix latana,* until he had mastered the proper technique, and had acquired exact knowledge of its structure. Then he applied the same intensive study to *Anabæna catenula* and *Nostoc cæruleum,* afterwards testing his discoveries on a large series of the most diverse Cyanophyceæ.

Many points of structure, especially those bearing upon the shape and structure of the resting nucleus, as well as its behavior during division, were made the object of study in cells stained *in vivo,* as well as in cells fixed by various chemical reagents. The most important contribution to our knowledge is that in regard to the nucleus. The author confirms Bütschli's and Hegler's contention that the central body (Zentralkörper) is the nucleus. This organ occupies the center of the cell and runs out in numerous tapering branches into the surrounding cytoplasm, these processes often extending to the cell wall. As ordinary fixation methods cause their immediate retraction, they usually have been overlooked. The nucleus has no definitely staining delimiting membrane, nor does it contain a nucleolus. In it, and in it alone, are contained certain granules named by Kohl 'centralgranules (Zentralkörner) and thought by him to consist of reserve stuffs. The apparent occurrence of these granules in the cytoplasm is explained by their being often found in the processes of the nucleus. Similarly, granules belonging in the cytoplasm sometimes appear to be in the nucleus, when they are imbedded in cytoplasm between the bases of the nuclear processes. The central granules are identified by Kohl with Bütschli's red grains, Nadson's Chromatinkörner, etc., and with the Volutanskugeln of the bacteria.

The cytoplasm contains various inclusions, chief among which are the cyanophycin granules (protein crystalloids), fat drops and certain semi-fluid bodies in the heterocysts which are found to fill up the pits in the cell wall at the point of attachment to adjoining cells.

According to many authors, this blue-green cytoplasmic mantle between the nucleus and cell wall is the single, cylindrical chromatophore. Kohl, however, combats this idea and considers as chromatophores the very numerous minute, colored bodies about 0.6 μ in diameter scattered throughout the otherwise colorless cytoplasm. In their reaction towards stains they behave as do the chromatophores of higher plants. A study of the coloring matter of the cell shows that besides chlorophyll and phycocyanin, there is also always present carotin, the xanthophyll of many authors, which is never absent where chlorophyll is found, throughout the vegetable kingdom. It is the combination of these coloring matters in various proportions that makes possible the great variability of color of the different species, or even within the species of this group.

Instead of starch these algæ produce as carbohydrate the nearly related glycogen, storing it, apparently equally distributed, in the cytoplasm and not in granules.

The cell membrane consists of chitin with a very small amount of cellulose and pectin. In the heterocysts, however, a layer of cellulose is laid down when it (the heterocyst) begins to develop. In those genera with sheaths the filaments lie free in the sheath except the heterocysts, which are grown fast to it. Kohl sees in this the explanation of the function of these cells. They serve as points of resistance in the formation of hormogones, and in the branching of the filament. What the function can be in the forms without a sheath he does not clearly explain. They are evidently, however, not reserve cells, for they originate by the formation of stoppers for the pores through which alone the adjacent cells could furnish or receive reserve stuffs. They then build the cellulose wall and totally degenerate.

Here and there in the filament a single cell or several cells soften and degenerate, forming the points at which the filament breaks when it divides or produces hormogones. In the forms with false branching such degenerated cells are formed below the heterocysts and seem to help soften the sheath wall so as to enable the filament to turn out through the sheath when the resistance of the fast-grown heterocyst prevents its growing further in a straight line.

Normally the cells have no cell-sap vacuoles. They resemble meristematic cells in the size of the nucleus and density of the cytoplasm. Only in old or terminal cells and in the heterocysts do such vacuoles occur. The so-called gas vacuoles that Kohl mentions as occurring in some Cyanophyceæ have been proved definitely by Molisch and Brand, working independently, to be not of gas nature.

All cells are connected by a fine thread of plasm, which penetrates the center of the pore in the cell wall; even in the heterocysts where the pore is filled up the plasma thread remains, but it is unable to convey enough foodstuffs to keep the heterocyst plasma in good condition.

The nuclear division was made the object of especial study. By staining the living cells with methylene-blue Kohl was able to follow the process without subjecting himself to the criticism that his chromosomes were artefacts. The nucleus consists of a ground mass and a difficultly visible fine chromatin-bearing filament. This thickens itself and finally forms a spirem. This breaks up into usually six straight chromosomes which arrange themselves parallel to the long axis of the thread. They then begin to bow in somewhat, until they are much farther apart terminally than centrally. They then divide *crosswise* in the middle, *not lengthwise*, and collect at each end of the cell. At this point in the division a few achromatic fibers are visible, connecting the two masses of chromosomes, but no spindle in the proper sense is seen. The daughter chromosomes arrange themselves parallel, then form a spirem. As the chromosomes divide, the body of the nucleus which retains its distinctness from the cytoplasm begins to pinch in at the middle, and soon the separation of the two nuclei is complete. A cell wall separates the new cells at once.

The author also discusses the relationship of the Cyanophyceæ to the bacteria, holding that they are closely related and that the latter too probably have a nucleus similar to that described.

The book is, unfortunately, marred by an excessive number of typographical errors. The ten plates illustrating the book are finely executed and are very helpful to the understanding of the subject.

ERNEST A. BESSEY.

Geology of Economic Non-metallic Minerals. By FRANCIS MIRON, C. E.*

This little volume is published as one part of the 'Encyclopédie Scientifique des Aide-Mémoire,' issued under the direction of M. Léanté, member of the Institute of France. It is the fourth by the same author, the preceding volumes having dealt respectively with: (1) Mineral oils, (2) subterranean waters and (3) metallic minerals and mining. The general object is to furnish a series of brief hand-books describing the geological distribution, manner of occurrence and methods of procuring and utilizing of the substances treated of in each of the volumes. The pres-

* 'Gisements Mineraux; Stratigraphic et Composition,' par François Miron, Paris, Masson et Cie, pp. 157. (Part of 'Encyclopédie Scientifique des Aide-Mémoire.')

ent one deals with economic minerals strictly, exclusive of metallic ores, and in the main of precious and ornamental stones.

The plan of the work is good, and the geological element in it is valuable; but the treatment is very unequal, some portions being well and fully presented, and others but inadequately. The work bears no date, and takes no note of some important recent developments, *e. g.*, that of monazite and the related rare earths. Its chemical formulas, too, are not modern. As a whole, the book is of interest in its suggestion of what might be, if the author's ideas were carried out more fully and comprehensively, errors and omissions corrected, and the treatment brought up to date.

G. F. K.

SOCIETIES AND ACADEMIES.

ONONDAGA ACADEMY OF SCIENCE.

At the October meeting of the academy, held in the Syracuse high school building, Dr. T. C. Hopkins presented an illustrated paper on the glaciers of Switzerland and Austria. The paper was based on field studies in the Alps during the past summer. It illustrated many features of the Alpine glaciers such as the snow fields, aiguilles, crevasses, moraines, gorges and the marked recession of many of the glaciers in recent years.

At the November meeting of the academy, held in the historical society rooms there were three papers on biological subjects:

1. *Diseases of Cultivated Flowering Plants:* George T. Hargitt.

The diseases were classified, according to the function disturbed, into three classes:

(*a*) *Disturbed Photosynthesis.*—The rusts are one of the commonest diseases of plant life and in the carnations it is caused by the fungus *Uromyces caryophyllinus,* one of the most serious diseases of this plant. *Darluca filum,* usually occurring in connection with this rust, is commonly considered as parasitic on the rust, but investigations seem to show it rather to be parasitic on the carnation. Plants affected by both the rust and *Darluca* are in worse condition than those affected only by the rust. The disease 'white legs' of the aster results in dwarfing, malformation and final decay. It is caused by nematode worms of the genus *Heterodera* or perhaps *Aphenenchus.* Leaf spot diseases, common in a great many plants, are caused by a number of different fungi.

(*b*) *Disturbed Transpiration.*—The rusts also cause a disturbance of the transpiration, which is usually the more destructive, due to the unguarded evaporation of water through the ruptures in the epidermis caused by the liberation of the spores. In carnations a disease called stigmonose is caused by the punctures of insects.

(*c*) *Interference with the Supply or Absorption of Water.*—The most destructive disease of this type is the aster wilt or stem rot. The characteristic effect is a wilting and a yellowish color first seen on one side of the plant, usually in one of the lower leaves. It is caused by the growth of a *Fusarium* fungus in the large water-carrying vessels, which are thus gradually clogged up. A more elaborate paper on this subject by Mr. Hargitt appears in the report of the Nebraska State Horticultural Society for 1903.

2. *Some Features of the Development of Flowering Plants:* Dr. J. E. Kirkwood.

The paper embodies the results obtained from the study of the embryology of about fifteen species of the Cucurbitaceæ. In all the forms examined the ovary begins by the invagination of a lateral shoot and the organs of the flower appear in the following order: sepals, petals, staminodia (when present) and carpels. In the early stages of embryonic growth the endosperm plays an important part by digesting the nucleus and nourishing the embryo.

3. *Bithynia tentaculata:* Albert J. May.

The gastropod *Bithynia tentaculata* was introduced into the United States from Europe and has become very abundant in New York. It was first noticed in this country in 1879, when specimens were taken simultaneously at Oswego and in the Champlain canal near Troy.

They seem to multiply and spread very rapidly. They are now reported from points all along the Hudson River and the Erie Canal. They are abundant in the Genesee and Niagara Rivers.

It is quite noticeable that wherever *Bithynia* appears the native forms appear to thin out rapidly.

The species is herbivorous, feeding on algæ and other plants. They are oviparous. The female deposits her eggs on stones and aquatic plants in a mass of gelatinous material which is covered with a tough elastic membrane. The eggs are laid in numbers varying from 15 to 25, in bands of two or three rows.

The December meeting of the academy in the high school building was addressed by Dr. C. W. Hargitt, on the subject of recent activities of Mt. Vesuvius. It was illustrated by photographs made during the last summer and ten years ago. The speaker illustrated many features such as the lava streams, the ash cone, the crater, the partially excavated Pompeii, and many of the small volcanic cones and associated phenomena in the vicinity of Vesuvius.

T. C. HOPKINS,
Corresponding Secretary.

THE CLEMSON COLLEGE SCIENCE CLUB.

THE Clemson College Science Club held its regular monthly meeting November 20, 1903. The first on the program was Mr. B. H. Rawl with a paper entitled 'Pasteurized Milk.' The speaker explained fully the objects desired to be accomplished in the pasteurization of milk. The differences between sterilization and pasteurization were pointed out. The speaker, while not minimizing the importance of pasteurization, emphasized the necessity of producing milk under sanitary conditions, thus preventing the entrance of harmful bacteria into the milk. This was considered more desirable than attempting to rid the milk of bacteria after their entrance by such processes as pasteurization, etc. Apparatus for pasteurizing in the home and on a commercial scale was described.

The next on the program was Dr. G. E. Nesom, whose subject was 'The Relation of Bovine Tuberculosis to Man.' This communication consisted largely of a selection of readings from a bulletin published by the author and papers published by Drs. Ravenal and Cary. The speaker referred to the distribution of tuberculous animals in the United States, the figures showing that Massachusetts contained the highest percentage. The number of tuberculous animals in the south and especially in South Carolina is relatively small. The speaker brought out the fact that there are no differences, morphological or otherwise, in the bacteria of human and bovine tuberculosis. The bacteria of bovine tuberculosis, however, are believed to be more virulent. Numerous experiments were cited to show the ability of bovine tuberculosis bacteria to cause the disease in man. The discovery and uses of tuberculin were pointed out. In view of the transmissibility of bovine tuberculosis to man, the speaker urged in conclusion the necessity of a thorough inspection of all animal products (meat and milk).

F. S. SHIVER,
Secretary.

DISCUSSION AND CORRESPONDENCE.

CONVOCATION WEEK.

THERE are various objects that may be achieved by a meeting of a body like the American Association for the Advancement of Science.

1. It must give opportunities for making the acquaintance of or renewing acquaintance with men whom one likes to know.

2. It must give opportunities for discussion of scientific subjects with those competent to discuss them.

3. It must give opportunities for learning of new discoveries and theories in the field of science, from those who are competent to describe them.

4. It may open the road to the publication of papers submitted, in such a manner as to command general public attention.

5. It may concentrate the influence of men of science, and give their views that power with the general public that can only flow from acknowledged authority.

The three objects first named may be measurably achieved at the meetings of every scientific society of specialists. The two objects last named can not be. They can be prosecuted only by a society for the promotion of all science: hence they should be specially cultivated by the American Association for the

Advancement of Science, which is practically the only American organization of that character.

The way to get the public ear is to get it, as far as one can, at first hand. The door of the American Association for the Advancement of Science is wide open for the public to enter. It should be. Sectional discussions are at their best when there are enough listeners to stimulate the speaker to do his best. Scientific statements are at their best when plainness of speech is compelled by a miscellaneous audience of people educated, indeed, but differently educated.

Therefore, I think the meetings of the association should be held when and where they will attract the largest attendance, and sectional meetings or meetings of affiliated societies so arranged as to make it easy for members to pass from one room to another, and hear something upon many subjects.

The largest attendance, I believe, can be secured in July or August. Convocation week is not even a free week for all college and university teachers; to school teachers it is seldom free; to business and professional men, rarely, if ever. Simeon E. Baldwin.

The meetings of scientific societies seem to me to serve a real purpose in affording a pleasant opportunity for the personal acquaintance of scientific men, but I can not think that they are otherwise a great factor in the progress of science. It seems to me to be highly expedient that all the affiliated societies should meet at the same time and place, but I do not think that this meeting should be coincident with any other great distracting event, because attention will thereby be diverted from the main object of the meeting, and because no city can comfortably distend its possibility of accommodation to include excessive numbers. A general meeting once a year ought to be enough, in view of the many local meetings, the restricted means of many of the members, and the great extent of the country. Both midwinter and midsummer are likely to be unpleasant for travel in America, and, therefore, early autumn seems to me the time when the largest number of members could be assembled, unless, indeed, the colleges could be induced to unite upon a common time for a spring vacation. Another argument against midwinter, but in favor of the spring or early autumn, lies in the fact that after April the results of a winter's laboratory work are usually in a more presentable condition than they were in the preceding December, while the following December often finds the papers already in print. This is, however, a secondary consideration, since the main office of the meeting is personal, rather than scientific.

Theodore W. Richards.

Before very much can be done in the way of bringing together men working in different scientific fields, it will be necessary to improve the meetings of the sections. Relatively few men go to the meetings of the American Association because they feel that they will lose something by staying away. The attendance is very largely the result of a sense of duty. One reason for this has been a mistaken idea on the part of the officers of the sections as to the real objects of the meeting. Each presiding officer has felt that the success of the meeting is measured by the number of papers presented before his section and he has done his best to overload the program. In order to finish on time, it has been necessary to ask that discussion of the papers be omitted or be made as brief as possible. To the people who do not read papers, the morning session becomes a trial of endurance with no enlivening features. After a few years of this, people lose all tendency to discuss and it is then necessary for the officers to overload the program.

In the afternoon things are not much better. The local members of the section are both hospitable and energetic. They arrange one or more excursions for each afternoon. People hurry through their lunch and walk round in crowds for hours, not understanding a quarter of what they see, and getting back to their hotels in a state bordering on collapse. It is all well meant, but it is a case of misdirected energy.

The usefulness of the meetings lies in the

personal element, in making men acquainted, and in giving them a chance to discuss things and to exchange ideas in a way that can not be done by letter. The mere reading of papers is a waste of time. Tagging round as one of a crowd on an afternoon excursion is a waste of energy.

The ideal meeting, as I see it, is very different. In the morning we should have short papers, if possible of general interest, and each paper should give rise to an animated discussion taken part in by as many people as possible. In the afternoon men should get together in small groups to talk over matters in a more careful way. There is no objection to one excursion, but that is enough. The evenings would then be left free for general social gatherings which certainly should not be confined to the single sections.

We get a little of all this now, but relatively little and that rather under protest. While there will be some differences of opinion as to what constitutes a successful meeting, it is certain that the meetings can be made of more value than they now are; and that the way to do it is for each member to decide for himself what he wants and then to work for it.

WILDER D. BANCROFT.

TO THE EDITOR OF SCIENCE: The desirability of so organizing and correlating the scientific activities of our country as to secure the largest results both in progress and influence can hardly be open to serious question. Just how to secure these ends is, of course, a difficult problem. We have some three types of scientific societies, two of which only are of immediate concern in the problem under consideration, namely, the more specialized or technical societies, such as the Society of Anatomists, Society of Bacteriologists, Society of Zoologists, etc., and those of broader or more general scope, of which the American Association for the Advancement of Science is representative. Of the other type, represented by the National Academy of Sciences, it is unnecessary to speak, since the exclusiveness of its membership as well as the fact of its independence of meeting as to both time and place do not bring it into direct relation with the more serious aspects involved in the correlation of the others as to times, places, programs, etc.

While in the first attempt of the conjunction of these technical and affiliated societies with the American Association at Washington a year ago there may not have been entire harmony, nor the realization of that adjustment of programs and hours of meeting which was hoped for, it may be doubted whether, as a whole, there has been a more enthusiastic meeting of scientific men from the entire country, with larger opportunity for congenial conference and acquaintance, in the history of such gatherings in our country.

While there must of necessity exist many of the strictly technical class of associations, and with increased specialization they are likely to become more rather than fewer, there still remains the no less imperative necessity for such organization of scientific effort as will make possible concentrated and consistent and direct sentiment for the enactment of needed measures of influence for whatever emergency may call for such. While this may have been measurably afforded by the Society of Naturalists, it was necessarily limited to a small class of scientists and to a limited range of territory. And though western sections, or *many* sections, be organized, there can never be anything like an ideal organization for aggressive work of a generally representative character through those sources. It may well be doubted, indeed, whether the day and the demand for the existence of the Society of Naturalists have not passed away, and whether a new demand under new conditions has not arisen which ought to be recognized and welcomed.

It is my firm conviction that there are in the American Association and in the technical societies conditions and factors which, properly correlated and adjusted, afford the most hopeful outlook for organized scientific progress within the present generation. And with the submergence of personal ambitions and aspirations and an earnest effort to secure the larger results of broad and well-organized effort an era of advance unparalleled may be entered upon.

CHAS. W. HARGITT.

To the Editor of Science: I cordially sympathize in your desire to have the scientific men of the country come together in the sessions of the American Association for the Advancement of Science. I learned to love the society in the ante-bellum days, when the greatest scientific minds of the whole country made it their business to attend and to participate in the discussions. Every year new members joined us, and we used to say, Mr. X was one of the number who came to us at the Providence or Montreal meeting, and has been a constant attendant ever since. It was more convenient then for the association to meet in the summer—and perhaps one may be excused for believing the warm season to be the best for these gatherings, because of the great success of those early meetings. I like your suggestion of having two meetings annually, one in the summer and the other in the winter, and I should say the localities might be chosen to fit the season—the far south in the winter, and the far north in the summer; or there might be a contrast between the east and the west.

With provisions for two meetings, some of the affiliated societies could arrange to meet by themselves, say in the winter, and in the summer to throw all their energies into their sections. It would be an important point gained if more interest was taken in the sections of the general association at one of the meetings.

Publication holds the first place in the thoughts of many. The question arises, Shall I present my subject before the section or before my special society; and the conclusion reached is usually in favor of the latter, because the paper may be published. If one has something important to present he wishes to have it printed. Of late years the American Association for the Advancement of Science has printed only the presidential addresses, and, therefore, the tendency is to slight the sections. If there were two annual meetings there could be two volumes printed, with some of the more important papers.

Then there is no opportunity for amateurs or new recruits to be represented in type unless there be some provision for the printing of papers. Perhaps I overlook the great service Science is doing for us, which prints some of the papers that do not appear in the *Proceedings*.

Section E has instructed its committee to arrange for a summer meeting this year. All will be interested to see the outcome of this move. The meeting will probably be held at St. Louis, and thus two questions will be answered by the results. Can there be an enthusiastic meeting of a single section in the summer, and can the section hold the attention of its members in the midst of the distractions of a world's fair? C. H. Hitchcock.

SPECIAL ARTICLES.

THE TOURMALINE LOCALITIES OF SOUTHERN CALIFORNIA.

The tourmaline deposits of southern California have attracted much attention recently, owing to the development of these mines for their gem stones. A recent discovery of lilac-colored spodumene has added considerably to the interest. For the purpose of acquiring a knowledge of the character of these tourmaline deposits and of studying the associated minerals, the writer spent several weeks among these mines last summer and collected some very interesting material. In this note is given a brief account of the principal localities and of the minerals that have been found there. The writer intends to make a complete study of this remarkable field, and especially of the minerals occurring in it, many of which are of more than ordinary interest. Some of the work has already been completed* and the remainder is well under way.

The gem tourmalines occur in rather large quantities, but are inferior to the Maine tourmalines both in color and in the brilliancy of the cut gems. The localities at which they have been found are comprised in an area less than thirty miles across in northern west-central San Diego County, extending into Riverside County and including portions of Smith's Mountain and the western part of the

* 'Spodumene from San Diego Co., California,' by W. T. Schaller, Bull. Dept. Geol. Univ. of Cal., Vol. 3, No. 13.

San Jacinto Mountains. The places where working mines are located are not many and may be grouped under four heads—those at (1) Pala, (2) Mesa Grande and (3) Oak Grove in San Diego County, and those at (4) Cuahuila in Riverside County.

1. The mines at Pala consist of the famous lepidolite mine from which the well-known specimens of rubellite come and the spodumene mine, about a mile away, which has already been described by the writer. The immense deposits of lithia minerals at the lepidolite mine occur in a pegmatite dike striking across a large body of diorite and dipping towards the west at a low angle. This dike is about a mile long and has a thickness of from twenty to eighty feet.

The pegmatite, in which large bodies of lepidolite and other lithia minerals occur, consists of a coarse muscovite-granite with garnets and black tourmalines. There are at least four of these large bodies of lepidolite exposed, only one of which is at present being mined. A conservative estimate of the size of this body of lepidolite, now in sight, would be $200 \times 100 \times 25$ feet. In some parts radiated groups of rubellite occur, and near the northern end of the body quartz and feldspar become rather abundant and the deposit seems to grade into the normal muscovite-pegmatite.

The pink clay—so often associated with gem tourmalines—occurring here has been determined to be halloysite. A large deposit of pure amblygonite, showing broad cleavage faces, has been uncovered. Numerous well-terminated green tourmalines, with complex combinations, have also been found, as well as several pounds of native bismuth and its oxidation products, bismuthinite and bismutosphærite. The bismutosphærite occurs in grayish-black masses and also as a yellow powder. A qualitative test showed the presence of carbonic acid and the absence of water. Doubly terminated quartz crystals are not uncommon. The list of minerals from this mine so far identified is lepidolite, tourmaline (black, green, pink), amblygonite, orthoclase, muscovite, quartz, kaolinite, halloysite, garnet, plagioclase feldspar, bismuth, bismuthinite and bismutosphærite.

At the spodumene mine the following minerals have been identified: tourmaline (black, pink, blue, blue-green), spodumene, lepidolite, beryl (pink), quartz, muscovite and orthoclase.

Very pale green, colorless and lilac-colored spodumene has been found in the mountains a few miles east of the mine.

2. The Mesa Grande district is the most important one for tourmalines. Two mines, only one of which was accessible to the writer, are situated here, both being located on the same series of pegmatite dikes. The country rock in which these muscovite-granite dikes occur is a diorite.

In the mine visited three such dikes are being followed, only one of which is at all rich in tourmalines. The dikes, only a few feet in thickness, dip southwest at an angle of 45° and are usually not much decomposed. Sometimes, however, the granite has become altered to a red clay and then this is carefully searched for loose tourmalines. Lepidolite is not abundant and is usually rather coarse. Muscovite, with a lepidolite border, is of frequent occurrence. Several fine crystals of lepidolite have been found in this mine, one complete crystal measuring 10 mm. across the base and having a height of 6 mm.

The tourmalines are mostly pale pink, though some red ones of good color, as well as green ones, have been found. Several good achroites have also been found, one in the possession of the writer measuring 35 mm. in length and 14 mm. in thickness. Besides the minerals mentioned above, quartz and orthoclase in large, complete crystals are found here. Garnet and beryl occur in the immediate vicinity.

3. The geology of the Oak Grove mine is similar to that of the other localities. Some of the cut tourmalines from this mine are exceedingly brilliant. Several fine yellow tourmalines have been obtained here. The minerals occurring at this mine are the same as those found at the Mesa Grande mine.

4. The Cuahuila locality is similar to the others, and the list of minerals found here includes tourmaline (pink, green, blue, blue-green, smoky, colorless, yellow and black), spodumene (the amethystine variety), beryl

(transparent pink crystals, one measuring 110 × 75 × 65 mm. and weighing 850 grams), lepidolite, pink andalusite, muscovite, orthoclase and quartz.

The field is certainly a very interesting one and is well worth further study. Many of the minerals occur in good crystals having rich combinations of forms, and the color of some of the specimens suggests interesting chemical possibilities. It is probable that with further exploration the list of minerals will be considerably increased.

Waldemar T. Schaller.
U. S. Geological Survey.

A NOTE ON RHIZOCTONIA.

The bean crop in the vicinity of St. Louis was severely injured this year in many instances by *Rhizoctonia*, sp. which not only attacked the stems and larger roots of the plants, but also produced brown, sunken areas on the surface of the pods, penetrating the latter and discoloring the seeds. An examination of a number of seeds whose surface was discolored disclosed the fact that the mycelium of the fungus had established itself in the seed coat and in many instances had formed minute sclerotia there without rotting the seed or even penetrating the cotyledons. Pure cultures of *Rhizoctonia* were easily obtained from a number of mature discolored beans which had been carefully removed from diseased pods. The presence of the fungus does not prevent the germination of the seed, as was proved by a test. From this it follows that a very common means of disseminating *Rhizoctonia* on the bean is through diseased seed, and that seedsmen should be careful not to send out discolored beans.

G. G. Hedgcock.
Mississippi Valley Laboratory,
St. Louis, Mo.

QUOTATIONS.

THE CARNEGIE INSTITUTION.

It is worth pointing out that the almost inevitable outcome of the present policy will be a centralization of a very objectionable kind. If the activities of the Carnegie Institution were to be wholly confined to aiding individuals here and there, that end could have been best attained by dividing the endowment among the leading institutions of learning, under such restrictions as might have been necessary. Every such organization could then have determined for itself, better than a central one at Washington, what the needs of its professors were, and what might be the importance of their work. It could have established branch stations at least as well as can the Washington institution. It could have sought out the exceptional man with even better chances of finding him, because its field of knowledge would have been wider than that of any central authority. Each could, for itself, have selected the best research-assistant to be found.

Now, instead of this result, we actually have a central authority passing judgment upon the relative importance of the work being done at all the institutions of learning from which applications may come, and aiding them, or refusing aid, according to their judgment. One very probable outcome of this has not been sufficiently considered. It must tend, to a greater or less extent, to diminish the spirit of individual effort, just as gifts are apt to do in many other walks of life. This effect will be intensified by a very obvious and reasonable provision announced by the institution as governing its action. It does not propose to undertake anything that is being well done by other agencies. It would, of course, be superfluous to assist a professor in cases where the patrons of his own institution could be induced to do so. The latter will naturally not be very liberal in giving their funds if the Carnegie Institution can be successfully appealed to. If the appeal is a failure, that failure will be a reason against the project in the mind of a possible donor. The dilemma will be that of Omar: If the Carnegie Institution can be induced to support your work, our aid is not needed; if it can not be so induced, the object is not worthy of our support. Of course, it is not claimed that this consideration will be universal, or will be operative immediately and in all cases. But to suppose that it will never be operative in any degree is contrary to every principle of human nature.

The progress of knowledge has brought us to a point where our nation needs the services of a body of men who shall be engaged in work of a distinctively different type from that carried on in our traditional institutions of learning, a work which belongs peculiarly to the present and future, because it was not possible in the past. Looking at our intellectual history, we have grown from the high school of our revolutionary ancestors to the college; from the college stage we have grown to the university stage. Now we have grown to a point where we need something beyond the university. We want an institution at the city of Washington at which shall be organized a system of research on that higher plane and larger scale which the progress of experimental science and observational knowledge now requires. Such a work would be at a disadvantage in being connected with any existing university for the same reason that the college was at a disadvantage when grafted on the preparatory school, and for the same reason that our universities are now at a disadvantage in being grafted upon the colleges. What we want might be appropriately called the National Research University. If the Carnegie Institution is not to grow into anything of this kind, is there not among us some possessor of great wealth ready to become its founder?—Professor Simon Newcomb in *The North American Review*.

EXPERIMENTS IN FLYING.

IN October last we resumed the trials on the Kill Devil practice ground with the machine which we had used during the previous year, and succeeded in making flights in which the operator remained in the air over a minute, at one time being suspended 1 minute 11.80 seconds. While carrying on the experiments, our power machine was under construction. In dimensions it measures a little over 40 feet from tip to tip of the wings, of which there are a pair. Its length fore and aft, to use a nautical phrase, is about 20 feet, and the weight, including that of the operator, as well as the engine and other machinery, is slightly over 700 pounds. We designed the machine to be driven by a pair of aerial screw propellers placed just behind the main wings. One of the propellers was set to revolve vertically and intended to give a forward motion, while the other underneath the machine and revolving horizontally, was to assist in sustaining it in the air.

We decided to use a gasoline motor for power, and constructed one of the 4-cycle type, which, revolving at a speed of 1,200 revolutions a minute, would develop 16 brake horse-power. It was provided with cylinders of 4-inch diameter and having a 4-inch stroke and intended to consume between 9 and 10 pounds of gasoline an hour. The weight of the engine, including the wheel, is 152 pounds.

We had calculated that this amount of mechanical power would be sufficient to maintain the machine in the air, as well as to propel it, the calculations being the result of gliding experiments, which showed that when the wind was blowing at a rate of 18 miles an hour the power consumed in operation was equal to 1.5 horse-power, while with a wind of 25 miles an hour it represented 2 horse-power, being capable of sustaining a weight of 160 pounds per horse-power at the 18-mile rate.

After the motor device was completed, two flights were made by my brother and two by myself on December 17 last. The apparatus had been placed on a single rail track, built on the level, the track supporting it at a height of eight inches from the ground. It was moved along the rail by the motor, and after running about 40 feet ascended into the air. The first flight covered but a short distance. Upon each successive attempt, however, the distance was increased, until at the last trial the machine flew a distance of a little over a half mile through the air by actual measurement. We decided that the flight ended here, because the operator touched a slight hummock of sand by turning the rudder too far in attempting to go nearer to the surface. The experiments, however, showed that it possessed sufficient power to remain suspended longer if desired. According to the time taken of each flight a speed varying from 30 to 35 miles an hour was attained in the air.

We should have postponed these trials until the coming season, but for the fact that we wished to satisfy ourselves whether the ma-

chine had sufficient power to fly, sufficient strength to withstand the shock of landing, sufficient capacity to control. Winter had already set in when the last trials were made, but these facts were definitely established, and we know that the age of the flying machine has come at last.—Wilbur Wright in *The Independent*.

NOTES ON INORGANIC CHEMISTRY.

Two papers have recently appeared in this country which, while not directly concerned with inorganic chemistry, have an important bearing on it. The first of these is a 'New Method for Determining Compressibility,' by Theodore William Richards and Wilfred Newsome Stull, and is published by the Carnegie Institution. Very little work has been previously done on the compressibility of inorganic substances, although such investigations are calculated to throw light upon the subjects of chemical affinity and cohesion. New methods have been devised by which the compressibility of nearly all solids and liquids can be determined up to 600 atmospheres or more. By means of these methods Richards and Stull have determined the compressibility at 20° of iodin, bromin, carbon tetrachlorid, chloroform, bromoform, water, phosphorus and mercury, while that of chlorin was estimated by extrapolation. Bromin is much more compressible than iodin, and it is probable that chlorin is still more compressible, being rather more than twice as compressible as water. Phosphorus is hardly half as compressible as water, while mercury was the least compressible substance measured, having a value less than ten per cent. that of water. In every case the compressibility decreases with increasing pressure. The authors suggest the use of the term *megabar* to indicate the pressure of a megadyne on a square centimeter, giving an absolute standard instead of the unscientific unit of an atmosphere. The value of a megabar is 75.015 centimeters of mercury or 98.703 per cent. of an 'atmosphere.' This the authors point out is more nearly the average pressure at the laboratories of the world than the arbitrary 'atmosphere' usually taken.

The second paper is on 'The Electrical Conductivity of Aqueous Solutions at High Temperatures,' by Arthur A. Noyes and William D. Coolidge. This is the first contribution from the recently established research laboratory of physical chemistry of the Massachusetts Institute of Technology, and concerns the description of the apparatus used and the results with sodium and potassium chlorid up to 306°. Great difficulty was encountered in devising a suitable conductivity cell which should fulfil the other necessary conditions and be capable of withstanding the great pressures at high temperatures. The cell finally found satisfactory was a platinum-lined soft crucible steel cell, with gold wire packing and quartz insulation. In the experiments with sodium and potassium chlorids it was found that the degree of dissociation decreases with the temperature. With tenth-normal solution of sodium chlorid this decrease is very rapid, from about 83 per cent. at 18°, to 60 per cent. at 306°, and indicates that the degree of dissociation is very small at the neighborhood of the critical temperature (about 360°). The conductivity of the vapor over a tenth-normal solution of potassium chlorid at 306° was too small to be observed with the apparatus, and is at all events exceedingly small. The investigations with this cell are being continued and it is hoped to extend the observations up to the critical temperature.

To the 'Quarterly Statement of the Palestine Exploration Fund' a paper is contributed by William Ackroyd on a principal cause of the saltness of the Dead Sea. After showing the insufficiency of the soil and rocks to furnish more than a fraction of the salt present, and that the theory that its saltness is due to its being a former arm of the Red Sea, which has gradually become concentrated, is not substantiated by facts, he claims that the most important cause is the atmospheric transportation of salt from the Mediterranean. As in other localities, the rain water would be charged with salt to a degree which varies in a direct manner with the velocity of the winds coming from the sea. This view is confirmed by the fact that the ratio of chlorin to bromin is approximately the same as that for these two elements in the Mediterranean.

IT has been generally accepted that Moissan prepared diamonds synthetically by chilling an iron rich in carbon, the supposition being that in the interior of the mass of iron, solidified on the exterior, the pressure on solidification must be intense, and that under these conditions the carbon crystallized in the form of the diamond. This position is very strongly attacked by C. Combes in the *Moniteur Scientifique*. In his paper he argues that Goeppert and Friedel have found plant remains in diamonds, showing that the crystals must have been formed at a temperature below at least 772°. At the temperature of fused cast iron the diamond is converted into graphite. The diamonds supposed to have been formed by Moissan were doubly refracting, and hence not diamonds. Moissan's analyses of his crystals were unsatisfactory for diamonds. Finally Friedel has proved that such a mass of iron as was used by Moissan really contracts on cooling instead of expanding, and hence the supposed pressure was not present. Thus it appears to Combes impossible that Moissan has prepared diamonds synthetically. It is, however, possible that Hannay was more successful in this respect. J. L. H.

RECENT ZOOPALEONTOLOGY.

THE SAUROPODA.

Two memoirs have recently appeared on this group which greatly extend our knowledge, from the Carnegie and the Field Columbian Museums.

'Osteology of Haplocanthosaurus.'* This memoir by Mr. J. B. Hatcher is devoted to a new sauropod which is decidedly more primitive than any of the American Sauropoda hitherto discovered. In an exhaustive memoir illustrated with six plates the author describes it in detail. The principal new points are the following: The spines of all the cervical and dorsal vertebræ are single or simple, as in the carnivorous dinosaurs, instead of double, as in *Diplodocus, Morosaurus* and *Brontosaurus*. There are apparently fourteen dorsal vertebræ instead of ten as in the above-named forms, and from thirteen to fifteen cervicals; five sacrals and about forty caudals. The locality is the classic one of Cañon City, from which Marsh secured his type of *Diplodocus* about 150 feet above the summit of the red Triassic sandstones; the author believes it to be a lower horizon, of greater age than the Como Bluffs. As regards proportions, the thoracic region is believed to be proportionately longer than in the other dinosaurs. The limbs are elevated, and *Haplocanthosaurus* appears to have been an essentially quadrupedal type.

As regards general questions, the author considers the Dinosauria as a subclass. He adheres to the use of the term Sauropoda in preference to Opisthocœlia Owen or Cetiosauria Seeley. In this connection it may be pointed out that while Owen defined the Opisthocœlia as the suborder Crocodilia in 1859, he recognized them as Dinosauria in 1875. *Haplocanthosaurus* is placed in the family Morosauridæ, which is considered the most primitive family of Sauropoda. An especially interesting point is its resemblance to a type recently described from South America.

A very valuable feature of the memoir is the discussion of the age of the *Atlantosaurus* beds and of the geological section at Cañon City. The author shows that Cope's *Camarasaurus* skeleton was probably found 350 feet higher than *Haplocanthosaurus*. The conclusion is that the beds are chiefly of Upper Jurassic age, but in their uppermost members they may represent a portion at least of the Cretaceous.

'Structure and Relationships of Opisthocœlian Dinosaurs.'* The skeleton on which

* 'Osteology of Haplocanthosaurus with Description of a New Species, and Remarks on the Probable Habits of the Sauropoda and the Age and Origin of the Atlantosaurus Beds,' by J. B. Hatcher, *Memoirs Carnegie Museum*, Volume II., No. 1, November, 1903. There are a few points requiring revision: The sacral ribs are described as 'parapophyses,' which a reference to the Permian ancestors of the dinosaurs will probably show to be incorrect. The theory that the Sauropoda were aquatic reptiles is through a misunderstanding attributed to Osborn.

* 'Structure and Relationships of Opisthocœlian Dinosaurs, Part I., Apatosaurus Marsh,' by Elmer S. Riggs, A.M., Publ. Field Columbian Museum 82, Geol. Ser., Vol. II., No. 4, August, 1903.

Dr. E. S. Riggs bases this interesting memoir was found in the Grand River Valley, near Fruita, Colorado, in 1900. As illustrating the enormous labor connected with the preparation of such a specimen it may be mentioned that three skilled men were employed for more than eighteen months in mounting it.

The author adopts the term Opisthocœlia as having priority over either Cetiosauria or Sauropoda. Of still greater novelty is his identification of *Brontosaurus* with *Apatasaurus,* the type of which is that of a young animal differing from the subsequently described *Brontosaurus* in juvenile characters only.

The material includes the last cervical vertebra and the entire dorsal, sacral and caudal series as far back as the twenty-fourth caudal. We thus for the first time come into possession of the exact characters of the dorsals and of the full series of anterior caudals. These are very accurately figured and described by the author. The formula, like that of *Diplodocus* and *Morosaurus,* is, dorsals, 10, sacrals, 5, caudals, 24+. The writer shows that Marsh placed too many vertebræ in the back in his restoration, while Osborn also erred in placing too many in the anterior portion of the tail.

The morphology of the sacral region of the Opisthocœlia in general is very accurately described, the only error being in the diagrammatic representation of the rib of the caudo-sacral, which should be like that of the primary sacrals and unlike that of the dorso-sacral as shown by reference to the Permian ancestors of the Dinosaurs. The author's theory (p. 185) of the early formation of the sacral vertebræ is also probably incorrect, because the primitive Diaptosauria (*Palæohatteria*) show very early a marked separation of the anterior sacral ribs from the posterior dorsal ribs.

The restoration of *Brontosaurus* is by far the most correct we have ever had. It illustrates especially the extreme shortness of the back and the marked elevation of the sacral spines.

H. F. O.

THE MILWAUKEE MUSEUM.

The Report of the Board of Trustees of the Public Museum of the city of Milwaukee may well be read in conjunction with Mr. Bather's article in *Popular Science Monthly* on 'The Functions of Museums,' as in it the custodian explains what has been done and what, with proper facilities, may be done for the public and for students. Mr. Ward's desire to give a proper representation of the animals of Wisconsin and of North America, before 'dabbling in foreign specimens' is a step in the right direction; the Milwaukee Museum is one of our larger municipal museums and yet much smaller institutions waste much time and effort in the endeavor to duplicate the work of the large museums, the result being a small ill-balanced display of heterogeneous objects with nothing properly represented.

Few realize how extensive is the fauna and flora of any given locality and how interesting and instructive is a properly arranged and well-labeled local collection. The importance and efficiency of a museum does not depend merely upon its size, but upon the manner in which its collections are cared for and utilized. Mr. Ward shows great courage in discussing the question of gifts to museums, and treats the matter much as did Mr. Bather. In the earlier stages of growth of a museum collections are often accepted with the proviso that they are to be kept by themselves, and later on these gifts prove so many millstones around the neck of the institution, seriously hampering the progress of the museum. The way out of the difficulty is pointed out by both Mr. Ward and Mr. Bather; either let the gift be confined to desirable specimens or exhibits that may form part of an orderly whole, or let them be declined. Those who really have the good of a museum, or for that matter, other institutions at heart, will appreciate and accept the proviso and contribute to its growth and progress.

The Milwaukee Museum has added to its exhibition series cases containing the birds of the region about Milwaukee and a case comprising the birds found at various periods of the year, the contents of this being changed according to the season; also a number of

living animals of the lower forms, and an exhibit of such wild flowers as may be in bloom.

The Nunnemacher collection of arms has been extended and it is noted that this probably contains the best series of firearms exhibited in any museum in the country.

There is the usual plea for more room and it is to be hoped that this plea may meet with a favorable response and the fine building extended to meet the exigencies of the case.

L.

THE SMITHSONIAN INSTITUTION.

WE reproduce from the Washington papers the accounts of the meeting of the regents of the Smithsonian Institution, held in Washington on January 27, which it is understood are given out by the secretary. As an adjourned meeting was held in the evening, for the first time in recent years at least, it may be assumed that the general policy and administration of the institution were under discussion.

The annual meeting of the board of regents of the Smithsonian Institution was held at the institution at ten o'clock on the morning of January 27. Of the members of the board those present were: Mr. Chief Justice Fuller, the chancellor of the institution, who presided; Senator S. M. Cullom, Senator O. H. Platt, Senator F. M. Cockrell, Representative R. R. Hitt, Representative Robert Adams, Jr., Representative Hugh A. Dinsmore, ex-Senator John B. Henderson, Dr. A. Graham Bell, Dr. James B. Angell, ex-Secretary of State Richard Olney and the secretary of the institution, Dr. S. P. Langley. Senator William P. Frye, president *pro tempore* of the Senate; Judge George Gray and Dr. Andrew D. White were unable to be present. It was announced that Representatives Hitt, Adams and Dinsmore had been reappointed regents on the part of the House for a term of two years, and that Mr. John B. Henderson and Professor A. Graham Bell had been elected regents from the District of Columbia for a period of six years.

The secretary presented his annual report reviewing the work of the year ending June 30, 1903. The total permanent fund now stands at $937,000, deposited in the treasury. Certain railroad bonds forming a part of the Hodgkins fund make the total fund of the institution about $1,000,000.

The institution in addition was charged with the disbursement of congressional appropriations for the United States National Museum, the Bureau of American Ethnology, the international exchanges, the Astrophysical Observatory and the National Zoological Park, amounting in all to $472,400.

Under the Hodgkins fund a memoir has been issued by Dr. Barus, entitled 'The Structure of the Nucleus,' and grants have been made to Profesor M. W. Travers, of University College, London, for researches 'on the attainment of very low temperatures'; to Dr. Victor Schumann, of Leipsic, for work on vacuum spectroscopy, and to Professor E. W. Scripture, of Yale University, for the construction of a 'vowel machine.'

The subscription to the Smithsonian table at the Naples Zoological Station has been renewed. During the year this table was occupied by eight American biologists, all of whom conducted special researches of value.

In the series of 'Contributions to Knowledge' two valuable publications have been issued, those of Dr. Barus and Dr. Schumann, while a memoir by Dr. Frederick W. True, entitled 'The Whalebone Whales of the Western North Atlantic, compared with those occurring in European Waters, with some Observations on the Species of the North Pacific,' and a work by Professor N. S. Shaler, of Harvard University, entitled 'A Comparison of the Features of the Earth and the Moon,' are in course of publication. A number of papers have been issued in the series of 'Miscellaneous Collections,' and a work by the late Dr. G. Brown Goode, 'What Has been Done in America for Science,' is now being prepared for the press.

The usual reports have been issued and greatly sought after. The library has received valuable additions from Gen. John Watts De Peyster, in Napoleonana, and on gypsies. The museum library has received two important gifts, being the E. A. Schwartz collection of books on American coleoptera, and the W. H. Dall collection of books on recent and fossil mollusks.

The institution has taken over for America the work of the International Catalogue of Scientific Literature.

At its last session Congress authorized the construction of a fireproof building for the use of the National Museum, at a cost not to exceed $3,500,000. The plans for this structure are now practically finished, and borings for the foundation have been made. The actual work will begin in warm weather, though it will probably be three or four years before the building is completed.

Two hundred and thirty-six thousand specimens

were received, making the present total over 5,650,000, and about 33,000 objects were distributed to educational establishments. Among the most interesting accessions were those illustrating the native arts and industries of Sumatra and the Straits Settlements, collected by D. W. L. Abbott; a series of models of United States war vessels and of land and naval ordnance; and some relics of General and Mrs. Grant, of much intrinsic and historic interest.

After paying a tribute to the late Major John W. Powell, the first director of the Bureau of American Ethnology, the report describes the continuance of the work, under the direction of its new chief, Professor W. H. Holmes. Systematic field work has been successfully prosecuted in many states and territories, and in Santo Domingo and Porto Rico. The preparation of the dictionary of Indian tribes has been taken up with renewed vigor.

The number of correspondents and beneficiaries of the international exchange service is now over 44,000.

In the National Zoological Park a new elephant house has been built. In view of the increased number of buildings in the park, each one of which has now to be provided with its own heating apparatus, it is recommended that a special building in the park, lying within a reasonable radius, be erected for a central heating plant. Much interest has been shown in the park by our officers abroad, of whom there may be specially mentioned Dr. F. W. Goding, United States consul at Newcastle, New South Wales, who has sent more than 140 specimens from that region.

The astrophysical observatory has been enriched by a large horizontal telescope, to be used for studies of special portions of the solar radiation. Results of uncommon interest have been reached in the bolographic work, and it has been shown that the earth's atmosphere has been more opaque than usual within the present calendar year, so as to reduce the direct radiation of the sun at the earth's surface by about ten per cent. throughout the whole visible spectrum, and by more than double this amount in the blue and violet portions of the spectrum. This alteration of the transparency of the air has not been confined to the region of Washington. A new determination of the temperature of the sun, based on the distribution of the solar radiation in the spectrum, has yielded a result of 5,920 degrees of the centigrade scale above absolute zero. A horizontal reflecting telescope of 140-foot focus and 20-inch aperture, and a coelostat of improved construction, to furnish at all times a 20-inch horizontal northerly directed solar beam, has been provided. The most interesting part of the results consists in showing a notable variation of atmospheric transparency which is likely to have affected climate and the growth of vegetation over a considerable part of the earth's surface, and in the studies relating to the solar constant, so that there seems renewed promise of progress toward the goal 'for telling by such means those remoter changes of weather which affect harvests,' which is one of the aims had in view in the foundation of the observatory.

The question of vandalism and exploitation for commercial purposes of archeological sites having been brought to the attention of the board, the following resolution was adopted: *Resolved*, that the passage by congress of an act for the preservation of archeological objects on the public domain is in the national interest, and would aid in promoting the science of archeology and ethnology; and that the secretary be requested to present to the congress the draft of a bill having this end in view.

Dr. Alexander Graham Bell, who was a committee of one on behalf of the regents charged with the duty of bringing the remains of Smithson to the United States, submitted a report. Dr. Bell reached Genoa on December 25, and on the 31st of that month the remains of Smithson were exhumed in the presence of the American consul and six other witnesses. He submitted a certificate of the United States consul, Mr. William Henry Bishop, describing the exhumation. Mrs. Bell then placed within the coffin a wreath of leaves from the grave of Smithson and the United States consul placed an American flag as a covering for the casket. Brief addresses were made immediately before the removal of the remains from the mortuary chapel by the United States consul and Dr. Bell and Mr. Noel Lees on behalf of the British burial ground fund committee.

The regents, after the report, voted that there be placed upon the record an expression of their profound appreciation of the services of Dr. Bell in going to Genoa and returning with the remains of James Smithson that they might find a resting place in the grounds of the institution he so nobly founded 'for the increase and diffusion of knowledge among men.'

A committee was appointed to choose the spot in the Smithsonian grounds where the remains of Smithson may be interred and a monument erected to his memory. The committee includes the chancellor, the secretary and the executive committee.

SCIENTIFIC NOTES AND NEWS.

DR. WILHELM WALDEYER, of Berlin, has been elected a foreign member of the Paris Biological Society.

PRESIDENT JORDAN, of Stanford University, will be absent from Palo Alto for about three weeks on a visit to the east. He will make an address at Yale University, at the meeting of the Association of American Universities, on February 18, and will visit other universities. Dr. Jordan has been invited to give the address at the opening of the new science building of the University of Colorado.

GENERAL I. J. WISTAR, president of the American Philosophical Society, Philadelphia, sailed on February 2 for a visit to the Mediterranean and the Orient.

DR. H. V. HILPRECHT, of the University of Pennsylvania, is making arrangements for another expedition to Babylonia next fall.

THE Council of the Geological Society of London has this year made the following awards: Wollaston Medal to Professor Albert Heim of Zurich; Murchison Medal to Professor G. A. Lebour of Newcastle-on-Tyne, chiefly in recognition of his work on the carboniferous rocks and in connection with coal; Lyell Medal to Professor A. G. Nathorst of Stockholm; Wollaston Fund to Miss E. M. Wood, joint-author of the 'Monograph on British Graptolites,' and assistant to Professor Lapworth of Birmingham; Murchison Fund to Dr. A. Hutchinson, demonstrator of mineralogy at Cambridge; the Lyell Fund is shared between Professor S. H. Reynolds of Bristol, who is whole or part author of several contributions to English stratigraphy, and Mr. C. A. Matley of Dublin, another British stratigraphical paleontologist; Barlow-Jameson Fund to Mr. H. J. Beadnell for his stratigraphical work in connection with the Egyptian Geological Survey. We understand that the new president is likely to be Mr. J. E. Marr of Cambridge. We regret to learn that the out-going president, Professor Lapworth, is still prevented by ill health from undertaking his professorial or presidential duties, among them the delivery of the annual address.

THE Royal Society of New South Wales has awarded the Clarke memorial medal to Mr. A. W. Howitt, of Melbourne.

DR. GEORGE F. KUNZ, special agent of the United States Geological Survey, has been appointed commissioner of the radium exhibit at the St. Louis Exposition, and has been authorized to prepare and procure material comprising radio-active substances of all kinds and also exhibits to illustrate the action of radium compounds, ultra-violet light and Röntgen rays upon mineral and chemical substances. This exhibit is to be made by the United States Geological Survey in the United States building at St. Louis. There will be a second exhibit of radium and radio-active substances in the mines building.

DR. F. H. BAKER, superintendent of the National Zoological Park, will be in charge of the aviary at the St. Louis Exposition. The cage for the flying specimens, now building at the fair grounds, will be 200 feet long, 60 feet wide, and 70 feet high.

THE patents of Professor Michael I. Pupin, concerned with long distance telephony, have been upheld by the German courts, as against the contention of the postal administration. Professor Pupin is at present in Berlin.

SIR WILLIAM WHITE, F.R.S., president of the British Institution of Civil Engineers, has been appointed a member of the Engineering Standards Committee.

AT the annual meeting of the Anthropological Institute of Great Britain and Ireland, Mr. H. Balfour gave an address and was re-elected president.

THE Zoological Society of London has elected the following members: Dr. Lorenzo Camerano, of the Royal Zoological Museum, Turin, Italy; Dr. Fritz Sarasin and Dr. Paul B. Sarasin, of Basle, Switzerland.

A SOCIETY for the prehistoric study of France has been founded at Paris, with M. Emile Rivière as first president.

THE president of the British Board of Trade has appointed Lord Rayleigh, F.R.S. (chairman); Sir William de W. Abney, F.R.S.; Robert Farquharson, Esq., M.D., M.P.; William King, Esq.; and J. Fletcher Moulton,

M.P.; to be a committee to inquire and report as to the statutory requirements relating to the illuminating power and purity of gas supplied by the metropolitan gas companies, and as to the methods now adopted for testing the same, and whether any alteration is desirable in such requirements or methods, and, if so, whether any consequential alteration should be made in the standard price of gas.

The Swiney prize, founded by Dr. Swiney, who died in 1844, for a work on jurisprudence, has been awarded to Sir Frederick Pollock, LL.D., D.C.L., and Professor Frederic William Maitland, LL.D., D.C.L., for their book on 'The History of English Law before Edward the First.' The prize consists of a silver cup of the value of £100 and money to the same amount. The award is made jointly by the Society of Arts and the Royal College of Physicians, and the prize, under the terms of Dr. Swiney's will, is given every fifth year on the anniversary of the testator's death.

Professor Debove, dean of the Medical Faculty of the University of Paris, has been appointed president of the French Consultative Committee of Hygiene, in the room of Professor Brouardel, who has been named honorary president. Dr. Roux, sub-director of the Pasteur Institute, has been reelected vice-president of the committee.

Professor Angelo Heilprin lectured before the People's Institute at Cooper Union, New York, on February 5, his subject being 'Mount Pelée Revisited.'

Dr. Charles B. Dudley, chief chemist of the Pennsylvania Railroad Company, delivered a lecture on February 1, at the Cosmos Club, Washington, on 'The Work of a Chemist on a Railroad.'

Lord Rayleigh will give a course of six lectures, at the Royal Institution, London, on 'The Life and Work of Stokes,' beginning on February 20.

An oil painting of the late Dr. Thomas G. Morton was presented to the Pennsylvania Hospital by the Association of Resident Physicians of that institution, January 11. Dr. Morton was connected with the hospital in various capacities for more than forty years.

We regret to announce the death of Arthur William Palmer, D.Sc. (Harvard), head of the Department of Chemistry of the University of Illinois. Dr. Palmer was graduated from the University of Illinois in 1883, and was for two years assistant in the Department of Chemistry. In 1890, after studying for two years at Harvard University and one year in Germany, he was appointed professor of chemistry and has since served continuously in that capacity. As member of the Chemical and Biological Survey, he had lately completed an important report on the water supply of the state of Illinois, and was the author of many papers embodying the results of chemical investigation.

The Rev. Dr. Jacob Cooper, professor of philosophy and rhetoric in Rutgers College since 1893 and previously professor of Greek, has died at the age of seventy-three years.

Dr. Friedrich von Hefner-Alteneck, the eminent German engineer, died on January 7 at the age of fifty-eight years.

Reuter's Agency reports that on January 16 the chief of the laboratory of the Imperial Institute of Experimental Medicine for the preparation of plague remedies, whose name is not given, was taken ill after having been engaged in experimenting with living plague cultures. He died of plague on January 20, in spite of every medical assistance and repeated injections of anti-plague serum. Injections of the anti-plague serum were made in good time into all persons who had been in contact with him. The laboratory is in Fort Alexander I., which is on a small island completely isolated from Kronstadt and the other forts.

Dr. Felix Kanitz, known for his archeological and ethnographical researches in the Balkan peninsula, died at Vienna on January 5, in his seventy-fifth year.

We also regret to record the death of Dr. August G. Garcke, professor of botany at Berlin, at the age of eighty-four years.

A despatch from Buenos Ayres to the *Figaro* announces that the *Français,* with

Dr. Charcot's antarctic expedition on board, reached Ushuaia, Patagonia, on January 15. An Argentine vessel brought her coal supply and mails, and the *Français* then left for the south.

THERE will be a civil service examination on March 9 and 10 to fill vacancies in the position of geologic aid and assistant geologist in the Geological Survey, at salaries ranging from $1,000 to $2,000 per annum.

BARON LÉON DE LENVAL, of Nice, has given 3,000 francs to found a prize to be awarded periodically to the otologist who has made the greatest progress in the practical treatment of the affections of the ear since the previous award, to the inventor of a portable apparatus susceptible of notably improving the hearing of deaf persons. The value of the prize is the interest on this sum accruing in the interval of two meetings of the International Otological Congress.

The Illustrated Review of Physiologic Therapeutics offers the sum of fifteen hundred dollars in cash prizes for the best essays on X rays in medicine and surgery, the first prize being $1,000.

SIR NORMAN LOCKYER'S address as president of the British Association for the Advancement of Science on 'The Influence of Brain Power on History' has been reprinted from *Littell's Living Age* by the New England Education League and International Education Conference. Copies may be obtained in large or small quantities at the rate of two cents each (postage extra) by addressing Mr. W. Scott, secretary, 40 Dover Street, West Somerville Station, Boston, Mass.

SENATOR CULLOM has introduced a bill for the preservation of aboriginal monuments, ruins and other antiquities to apply to all government reservations.

THE agricultural appropriation bill, as passed by the house on February 5, carries a total of $5,711,240, being an increase of $233,080 over the current law. Only two salaries are raised by the bill, and these only temporarily, being $500 each to the chiefs of the Bureau of Animal Industry and the Division of Entomology. Commenting on the amount carried, Chairman Wadsworth says in the report: "It has been asserted by some that the United States is not spending enough toward the promotion of agriculture. Having this in mind your committee requested the Census Bureau to furnish it with statistics showing the amounts spent by the several states and territories for this purpose, and as near as can be ascertained by that bureau the aggregate yearly expenditures by the states and territories are something over $4,500,000, which, added to the $6,250,000 spent annually by the United States government for the same cause, makes a total of $10,750,000 spent annually for the promotion of agriculture. Certainly," the report concludes, "this is a most liberal figure and much more than is being expended by any other government in the world for the same purpose." The bill contains the following new clause regarding the relation of the agricultural experiment stations to the Department of Agriculture: "The Secretary of Agriculture is hereby authorized and directed to coordinate the work of the several stations and the work of the stations with the Department of Agriculture, to the end of preventing unnecessary duplication of work, of increasing the efficiency of the stations and the Department of Agriculture, and to unify and systematize agricultural investigations in the United States."

IT appears from the reports in the press that in discussing the agricultural bill in the house on February 5, Mr. Sheppard (Dem., Texas) made a determined but vain effort to bring about a reform in the matter of the distribution of seeds by the government, and specially for the purchase of rare and untried seeds. He read a letter from a constituent who asked him to send certain seeds and in addition a suit of clothes. He declared that the system was degenerating into a farce, and said that if the congressional comedy continues and drifts into a continuous performance, congressmen will no longer be statesmen but seedsmen. Mr. Sheppard developed to the merriment of the house, in a colloquy with Mr. Candler, that the latter had received a request from a man for a hat for himself and his wife. Mr. Cochran (Dem., Mo.) said he re-

ceived a letter from one of his constituents a few months ago asking for a piano for his daughter. Mr. Cochran wrote back that he was very sorry that he could not gratify him, but he was in the minority and could not get any allowance of pianos. However, he said, Mr. Bartholdt, being the only republican from the state, could get all the pianos he wanted. He had just received twelve as his allowance. In a few days Mr. Bartholdt got several letters asking for pianos, and now he is receiving four or five letters every day from Missouri making the same request.

A CORRESPONDENT writes as follows to the London *Times* with reference to Mr. J. S. Budgett, of Trinity College, Cambridge: By the death of Mr. Budgett Cambridge has lost one of the most promising of her biologists and one of the most active of those who take an interest in volunteering in the university. Mr. Budgett was educated at Clifton College and came up to Trinity College about ten years ago. From early childhood he showed a keen interest in all matters of zoological interest; and these tastes whilst he lived in his father's house at Stoke Bishop, near Clifton, were fostered by the friendship and sympathy of Professor Lloyd Morgan and of Professor S. H. Reynolds, of University College, Bristol. During his third year at Cambridge Mr. Budgett accompanied his friend Professor Graham Kerr to the Gran Chaco of Paraguay, where he made large collections of the local fauna, especially of amphibians and birds. Returning to Cambridge, he took his degree in 1898, and almost immediately started for the Gambia. Here he remained the best part of a year endeavoring to secure material for the study of the development of the archaic fish *Polypterus*. He revisited the Gambia in the rainy season of 1900 with the same object; and although in these trips he did not absolutely succeed in his object he collected a vast quantity of valuable material, notably a complete series of the eggs and larvæ of the African lung-fish, *Protopterus*, and of several other fresh-water fishes and amphibians. In 1902 Mr. Budgett was appointed Balfour student in the university, and with indomitable courage he renewed his efforts to solve the riddle of the development of *Polypterus*. He set out in June for Uganda, and proceeding from Mombasa by the Lakes Victoria and Albert, his caravan reached the head waters of the Nile, and he finally returned home by the Sudan and Egypt. Last June he started on his fourth and at last successful expedition to Africa. On the delta of the Niger he found what he had so long and courageously sought, and he returned home last November with a complete series of eggs and larvæ of *Polypterus*, and immediately began to work up the material he had collected. On his return it was evident that his health had been affected by the climate. Mr. Budgett was a man gifted in many ways. His power with the pen and pencil were a great help to his scientific work. In 1901 he raised a detachment of mounted infantry in connection with the Cambridge volunteers, and has continued to command that body till his death. He was a man of strong personality, and of a high and sensitive personal honor.

THE fifth International Congress of Zoology, held at Berlin in 1901, selected Switzerland as the place of meeting for the sixth session, and elected Professor T. Studer president. *Nature* states that in accordance with this resolution, the congress will meet at Bern from August 14–19 of this year. Professor Studer, Bern, is president of the general committee, and the vice-presidents are: Professor E. Beraneck, Neuchâtel; Professor H. Blanc, Lausanne; Dr. V. Fatio, Geneva; Professor L. Kathariner, Fribourg; Professor A. Lang, Zürich; Professor E. Yung, Geneva, Professor F. Zschokke, Basel; and Professor R. Blanchard, Paris. The secretaries are Professor M. Bedot, Geneva; Dr. J. Carl, Geneva; and Dr. W. Volz, Bern. The general meetings will be held in the Palace of Parliament, at Bern, and the sectional sittings in the new university. During the congress there will be an excursion to Neuchâtel and to the Jura lakes, in order to visit the lake-dwellers' settlements. The closing meeting of the congress will be held at Interlaken. Afterwards members will be invited to visit other Swiss cities. Communications or inquiries referring to the con-

gress should be addressed to the president of the sixth International Congress of Zoology, Museum of Natural History, Waisenhausstrasse, Bern. The congress is open to all zoologists and to all who are interested in zoology.

COLUMBIA UNIVERSITY, in cooperation with the Academy of Political Science, has arranged for a series of nine free lectures on 'The Problems of Municipal Administration,' to be given in Earl Hall by the heads of departments of the last city administration. The lectures are to be as follows:

February 26—'The Dock Department' (illustrated), McDougall Hawkes.

March 4—'The Street Cleaning Department' (illustrated), John McG. Woodbury.

March 11—'The Police Department,' Gen. Francis V. Greene.

March 18—'The Fire Department,' Thomas Sturgis.

March 25—'The Board of Education,' C. C. Burlingham.

April 1—'The Department of Charities,' Homer Folks.

April 8—'The Tenement House Department,' Robert W. DeForest.

April 15—'The Health Department' (illustrated), Dr. Ernst Lederle.

April 22—'Bellevue and Allied Hospitals,' John W. Brannan.

The British Medical Journal states that new county buildings at Chelmsford containing laboratories for Essex were formally opened recently by the Earl of Onslow, president of the Board of Agriculture. The new buildings, which are conveniently situated near the center of the town, have cost about £12,000. They comprise chemical, physical and biological laboratories and class rooms, together with agricultural and horticultural museums and libraries, and provide facilities for systematic instruction in agriculture and horticulture, as well as in pure science. They are under the control of the Essex Education Committee, and were built by the Essex County Council. As the chairman of this committee, Mr. E. N. Buxton pointed out at the inaugural proceedings that Essex was an agricultural county and the laboratories were intended to be a center for agricultural or horticultural information for the whole county; they included rooms for the analysis of soils, manures, foods, seeds, etc., and for other scientific work carried on in the interests of these industries. There is also a large dairy, in the basement, for instruction in butter and cheese making and the treatment of milk, and within three quarters of a mile is the school garden, three acres in extent, provided with pottingshed and hothouses. In addition to the more purely agricultural and horticultural courses of lectures and practical work, classes are held in chemistry, physics and biology, largely for the training of teachers. Several scholarships are offered by the county council, while several of the classes are free to selected candidates resident in Essex. The laboratories are large, well arranged, and well fitted up, and should prove, with the agricultural departments, of great service to the cause of agriculture and technical education in Essex. In the prospectus of the dairy school it is stated that 'it is also proposed to give a one-week's course of instruction in milking and the treatment of milk for selling.' Such a course, if properly given and attended, should be of value in promoting a more satisfactory and hygienic treatment of milk, and will be welcomed by all interested in a pure milk supply.

PROFESSOR HARRY FIELDING REID, of Johns Hopkins University, who is in charge of earthquake records for the United States Geological Survey, was designated by the State Department as the delegate from the United States to the International Seismological Conference held in Strassburg last July. The object of the conference, which was held at the invitation of the German Government and was attended by delegates from nineteen countries, was to form an International Seismological Association of the various countries for the purpose of cooperative work in such earthquake investigations as could be carried out only by cooperation. The conference adopted a constitution, which is to be submitted to all civilized countries, and they will be asked to join the association. The constitution provides for a general assembly, to meet at least once in four years, and a permanent commission, composed of one delegate from each

nation, which will direct the work of the association in accordance with the resolutions of the General Assembly. A Central Bureau is to be located at Strassburg in connection with the Imperial Seismological Station there, and reports are to be forwarded to its director as frequently as possible. These reports will be edited and published. The nations, members of the association, are to contribute sums varying from $100 to $800 annually, according to their population. The amount thus obtained is to be used for the expenses of administration and publication and may be used in part for such special purposes as the prosecution of special investigations ordered by the General Assembly or for the support of particular observatories founded by the association, observations from which are considered of special importance, and which could not otherwise be made. Each country is to enjoy the utmost liberty in the method of making observations and in the choice of instruments, but the reports are all to be sent to the Central Observatory in terms of Greenwich civil time.

UNIVERSITY AND EDUCATIONAL NEWS.

Professor John Hays Hammond has added $50,000 to his previous gift of $50,000 for a metallurgical laboratory of Yale University.

The late James A. Woolson has left his property in trust for his wife and daughters and their issue, if any, after which it is to go to public purposes. Boston University will ultimately receive $600,000, Radcliffe College $300,000 and the Wesleyan Academy at Wilbraham, Mass., $300,000.

The University of Michigan has received from Arthur Hill, of Saginaw, eighty acres of land just outside Ann Arbor, to serve as an experiment farm for the Forestry Department. The tract is called 'The Saginaw Forest Farm.' The tract is to serve as an object lesson in forestry and is planned to provide for: (1) An arboretum of all useful forest trees suited to Michigan. (2) Demonstration areas for seed bed and nursery work. (3) Model plantations of forest trees. (4) Special experiments in forestry, such as the various methods of propagation of special kinds of timber and the raising of particular kinds of forest products, as well as for other practical purposes. The university has also received from Mr. Joseph B. Whittier, of Saginaw, $4,000 for the Angeline Bradford Whittier fellowship in botany, in honor of Mr. Whittier's mother, and from the Michigan Federation of Women's Clubs, $3,000 for a scholarship for women. The sum will later be increased to $5,000.

Mr. Alfred Palmer has written to the principal of University College, Reading, offering to present to the college a site for the proposed new college buildings. The extent of the gift is about five acres, centrally situated.

President Ira Remsen, of the Johns Hopkins University, will give the commencement address at the Worcester Polytechnic Institute in June next.

The new medical laboratories of the University of Pennsylvania will be dedicated next June, and the medical department will move into its new quarters during the summer.

The Northwestern University has established in the College of Liberal Arts one hundred scholarships open to students from any part of the country who may be able to comply with the conditions. The scholarships are to be assigned upon a new basis, which resembles in some respects the Rhodes scholarships. The chief emphasis in the selection of students will be laid upon promise of superior achievement or probable fitness for public usefulness after leaving college.

Mortimer E. Cooley, professor of mechanical engineering at the University of Michigan, was appointed dean of the engineering department at the last meeting of the regents. He succeeds the late Charles E. Green, who was dean of the department from its foundation until his death in October last.

At University College, London, the Derby scholarship in zoology has been awarded to Mr. W. N. F. Woodland.